THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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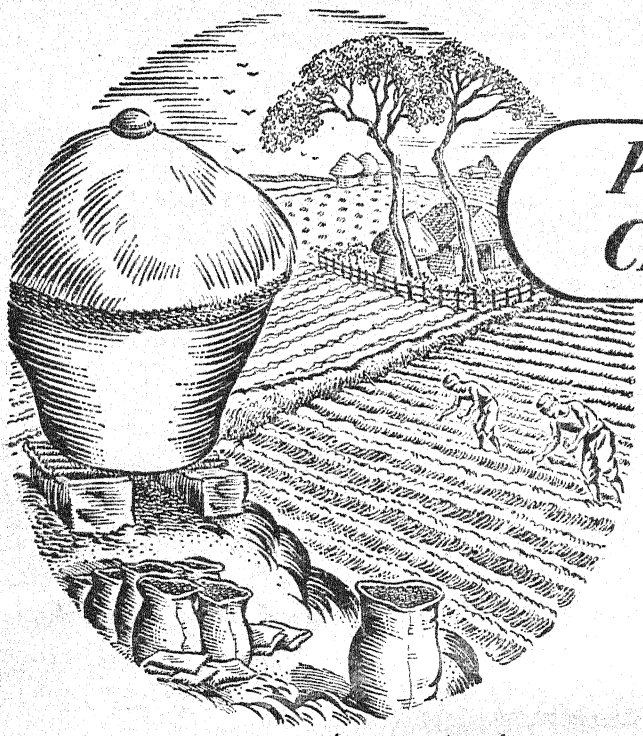

Planned Cropping . . .

HAPHAZARD cropping has no place in good farming. The farmer knows he must plan ahead for every season, more especially today when the importation of food is so difficult and it behoves everyone to put his land to the best possible use. Planned cropping means not only rotational crops—it means also maximum production from every foot of land. Scientifically conducted experiments have shown that the application of 1 to 4 mds. per acre of Sulphate of Ammonia, according to the crop, will give an increased yield of over 30 per cent, so that three treated acres will produce a crop which four untreated might be expected to give.

The yield of paddy in this country is far below our requirements and is lower than in many other countries. If we are to produce all we need we must increase not only the acreage but the yield per acre, by growing more improved varieties and by manuring them adequately. Here nitrogen, along with other plant foods, is of outstanding value and applied at transplanting or before flowering can give greatly enhanced yields. A small application after excessive inundation revives the crop and frequently means the difference between a satisfactory out-turn and no crop at all. In general not nearly enough use is made of nitrogen and it can be profitably employed to the improvement of both yield and quality.

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THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

The ALLAHABAD FARMER is now approved by the Directors of Public Instruction in the United Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Reconstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools under their jurisdiction.

Subscription Rates

Annual subscription : India, Rs. 3 ; England, 4 shillings ; U.S.A., 1 dollar. Single copies 10 annas ; over five years old, 12 annas. Copies which are not received by subscribers will be supplied free of cost within six months of the month of issue. Thereafter single copy prices will be charged.

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Advertising Rates

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Page 2 or 3 of cover for six numbers	50	0	0
Page 4 of cover for six numbers	70	0	0

Contributions

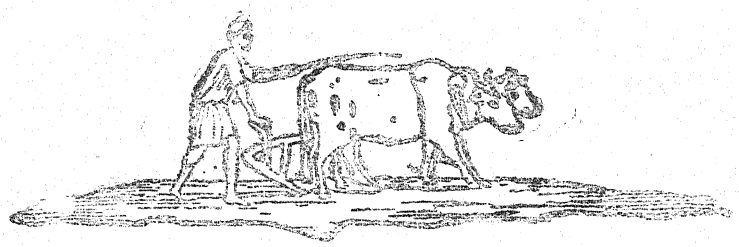
The ALLAHABAD FARMER is published in the first week of each alternate month commencing with the month of January. Contributors are requested to send in their articles at least one month prior to the next prospective date of publication.

Contributors will receive 15 reprints of the article published and additional copies at cost.

Publisher—The Allahabad Agricultural Institute, Allahabad, U.P. (American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U.P.

THE ALLAHABAD FARMER



VOL. XX] JANUARY—MARCH, 1946 [Nos. 1 & 2

Editorial

Food for the Nation.

The Woodhead Commission in their final report made the following declaration: The State should recognize its ultimate responsibility to provide enough food for all. In India the problems of food supply and nutrition are fundamental and must, at all time, be one of the primary concerns of Central, Provincial and State Governments". The Government of India accepting this conclusion arrived at by the Commission have also stated that their "aim will be not only to remove the threat of famine, but also to increase the prosperity of the cultivator, raise the levels of consumption and create a healthy and vigorous population."

In view of the impending food shortage in this country as well as throughout the world, the nation will, therefore, watch with interest the steps which Government will take in order to implement the declaration stated above. It seems to us that the matter is very urgent and that measures to alleviate the suffering of the hungry millions should be immediate, comprehensive and strong. No half-way measures, we believe, will meet the situation. The problem should be tackled in all fronts.

The immediate help that appears to be available on the horizon is the import of wheat from Canada, Australia, the U. S. A., and other wheat exporting countries. It was somewhat comforting to learn of the news coming from Canada that country has 140 million bushels of wheat available for export during the next six months. While India's share of this export may be very small, yet it will, we hope, ease the world situation somewhat.

Another immediate step is, in our opinion, the procurement of all available food grains, especially wheat and rice by Central as well as Provincial governments, to be distributed throughout the country wherever it is most needed. In spite of the very abnormal conditions that prevailed throughout the country during the last cropping season, we believe that with proper distribution of food grains available in this country, no part of the country need face the kind of suffering and starvation that Bengal faced in 1943-44. Increasing storage facilities controlled by government at key places throughout the country will help greatly to create confidence in the mind of the people who may feel inclined to keep back what may be a surplus amount of grain for them. These, if scientifically managed so that stored grain pests are entirely eliminated, would add greatly towards the amount of food grain which ultimately becomes available to the consumer. Also, unless procurement is comprehensive so that no loophole

HOW TO ENLARGE THE FAMILY FARM BUSINESS.

By

Mason Vaugh.

Agricultural Engineer, Allahabad Agricultural Institute.

A previous article "What is the Economic Unit in Agriculture?" by Mr. Arthur T. Mosher discussed the impropriety of trying to determine artificially the "Economic Unit" for the family size farm. That article pointed out that the proper size of farm business varies according to the size of family and according to the personality traits of the members of the family, and according to the types of agricultural production in which it is engaged. At the same time, it recognised the necessity of enlarging the size of practically all farm business in India if farm families are to have an adequate standard of living. This article is devoted to a discussion of various methods by which the size of the family farm business can be enlarged.

Studies by rural economists and agricultural engineers have shown that, in a uniform type of cultivation, income per worker or per family is closely related to the size of the farm business; the man who alone can cultivate 100 acres will generally have a larger income than the one who, *by the same method*, cultivates 50 or 25. This is perfectly valid. It is equally true that other methods than the increase in area can increase the size of the farm business and so increase the family income. Some of the ways in which the farm business may be enlarged might be listed as follows:

1. Increasing the area of the farm.
2. Improving the implements with which the farmer works.
3. Increasiug the non-human power per farm worker.
4. Increasing the yield per acre.
5. Improving the efficiency of livestock.
6. Developing a well integrated and co-ordinated system of farming.

Increasing the Area of the Farm.

The coming of better equipment into use makes it possible for one individual to cultivate a larger area than he could with less efficient implements and without a reduction in the yield per acre. Where there is ample land available and where the fertility of the available land is high, the easiest way to increase the size of the farm business is to increase the area of each farm. This appears to have been the course of developments in Western Countries, particularly America. It has paralleled a similar development in industry where improved equipment has led to increased output. Before 1800, one man could manage about 30 acres of farm crops in most parts of the then settled U.S.A. and roughly 75% of the population was required to feed the population. When shortly after 1800, improved implements began to be widely available, the size of the farm tended to increase in America mainly by the release of workers from agriculture and the absorption of them into manufacturing, transportation and services formerly performed in the home or not at all. New land was brought into cultivation by the expansion in the population for the most part, though some new land went to increase the size of the farm. This is indicated by the fact that the average size of farm in 1935-1940 was about 155 acres. Exact figures are not at hand, but, probably, not more than 100-125 acres of this was cultivated or roughly four times the area cultivated by one man before 1800. This parallels a change from roughly 75% engaged in agriculture before 1800 to roughly 25% in agriculture in 1935-1940. In other words, one farmer had acquired approximately the farms of

2 others with a small increase from the area added to cultivation. This change has tended to concentrate attention on the effect of size of farm, outside as well as inside the U.S.A.

Until recently, attention of most agricultural workers in India has been focussed on increasing acre yields. Some attention has been given to the consolidation of holdings, in the sense of bringing all the plots owned by one man together by exchanges. Only a few have talked for a long time about the necessity of increasing the size of farms, though it has been popular with politicians to demand an increase in the *grazing area*. Few if any have indicated clearly how they expected the grazing area to be increased or how the farms were to be enlarged to "economic areas". Recently, the changed situation due to the war has led to a demand for "co-operative farms" as a means of getting "economic units" for the use of large machinery. It is even being advocated that compulsion be used to bring about such changes.

Can, and if so, how, can Indian farms be increased in size and to what extent? The figures quoted in the past have been confused as to the size of farms at present. Two different figures, each perfectly legitimate, have been used, and often confused for each other. One is the average size of *holding*, the area shown by the land records as being held on some basis of permanent tenure by a cultivator. The other is the *area per person* under cultivation to crop arrived at by dividing the cultivated area by the population. Naturally, the latter is much smaller than the former. Apparently, some speakers and writers tend to use the latter for the former. We will try to keep the distinction clear in the following:

The area per person of population can be increased by bringing more land under cultivation; if the population increases again, this will in turn again reduce the area per person unless the bringing of more land under cultivation is simultaneously continued. The size of the holding or of the individual farm can be increased by reducing the proportion of farmers to population, that is by combining farms and finding other occupations for the remaining farmers or by the allotment of the increased area under cultivation to existing farmers or by both processes.

First, what is the possibility of increasing the area under cultivation? Again, the figures published by various people vary. The Bombay Plan of Economic Development shows, for all India, 94 million acres of "culturable waste" land against 208 million acres now under cultivation, a potential increase of 45 per cent. The U. P. Agricultural Pocket Book shows 9.988 million acres culturable waste and 38.8 million acres now cultivated, about 25 per cent possible increase in cultivated area. This assumes that all the "culturable waste" is really culturable. The Bombay Plan expresses grave doubt whether it is really all culturable or not. I think this doubt is well founded. However, some extension in area is possible, probably from 25 per cent to 40 per cent, varying from district to district and with methods of cultivation. Certainly much of this land is thin, poor upland of low fertility. If all this land is used to increase the size of farms, the 5 acre holding could be increased to one of 6 to 8 acres.

Because of the lack of available new land, the size of the farm can be increased more by reducing the number of farmers than by increasing the area under cultivation. There are various ways in which the number of farmers to be accommodated in India can be reduced. Two may be dismissed at once—a reduction in the population and emigration. There is nothing at present to indicate a *reduction* in population, *though it is urgently necessary to find ways of checking the present tremendous rate of increase.* Emigration has been effective in populating vacant areas and freedom of emigration is desirable for other reasons; it has not proven effective in the past in reducing the population of overcrowded areas.

What are the possibilities of such combining of areas? At present about 75 of the population is engaged in farming and 25 per cent in non-farming occupa-

tions. If we reverse these figures, have 25 per cent of the population engaged in agriculture and 75 per cent in non-agricultural occupations, we would then theoretically have $\frac{1}{3}$ as many farmers as at present and each farm could be 3 times as large as at present. That would mean farms of 15 to 25 acres for most parts of India. Actually, this situation is complicated by the large number of landless agricultural labourers in India. In many cases there are as many landless labourers as there are "farmers" having cultivating rights in land. It would be logical that they would be the first to go into industrial employment if such employment were increased or that some of them would take the places of present "farmers" who might prefer to migrate to industrial employment. In any case, the increase in area per farm would not be directly in proportion to the change of occupation but much less. Possibly the transfer of 50 per cent of the *population*, 2/3 of the present *agricultural population*, to industrial occupation might double the area per farm, assuming a stable population. If we add the 25 per cent increase in cultivated area the new farm might be as much as 2.5 times the present area. This is a useful increase in the farm business but would still leave the farms in the classification of small farms.

Increasing the Farm Business through Improved Implements.

The effect of the implements used on the size of the farm business—on the profit derived from a holding—has not had much attention in India. In fact, the common attitude of agricultural workers has often been that it is "impossible" to get along without the old wooden plough and that improved implements were comparatively unimportant. This is a mistaken view. While no one implement will entirely substitute for the old wooden plough, a comparatively simple and low cost set of equipment will do everything the wooden plough will do, will do it better and will do some things the wooden plough cannot. With such a set, the farmer can cultivate 2 to 3 times the area now commonly cultivated as one farm, thus making it possible for 25 per cent. of the present population to cultivate the available area suitable for cultivation, including the possible extension of cultivated area.

With mechanised power equipment—tractor drawn equipment—it is possible for one man to handle up to 150 acres of mixed crops in suitable rotations annually, or 5 to 10 times as much as he can with simple small animal drawn equipment. This also means that the population engaged in agriculture could be proportionately reduced. This may or may not be desirable. Some of the implications of this are discussed in the third article of this series, "The Co-operative Farm, Is it the Solution of India's Agricultural Problem?" There is not space to discuss it here; some implications of these changes will be discussed briefly at the end of this article.

The Effect of Increasing the Yield per Acre.

The size of the farm business is determined by the amount of crop available through the year for consumption or sale, not by the area cultivated. While increasing the area cultivated will usually increase the amount of crop produced, the same effect in some degree can be secured by improved production per acre. Yields in India are in general low. Improved farm practices such as the use of improved varieties, better rotations, better soil culture practices and in some cases other crops than at present grown can in most cases greatly increase the total crop yield available from a given holding. The adoption of better varieties and of other crops may give increases of 20 per cent. to 100 per cent. or more; improved varieties are not commonly introduced unless they give at least 25 per cent. increase in yield and improved varieties of sugarcane for instance may

give 200 per cent. to 300 per cent. of the old varieties. Vegetables, potatoes, sweet potatoes may give several times the food value per acre, as well as several times the sale value of grain crops. Better soil culture made possible by better implements, particularly better manuring such as green manuring, may double the yield of some crops. The use of commercial fertiliser (chemical manures) may in some cases further increase the yield.

These increases are largely independent of the area cultivated in that they can be applied to larger or smaller areas. By the use of suitable combinations of these means, it should be possible for most farmers to double the size of their farm business. Some of them can be introduced with very small investments, others such as the provision of irrigation will require larger investments. Practically any ordinary village farm can be made to produce at least twice its present output without large investment of any sort. This is perhaps the place where the ordinary farmer by his own initiative and without the necessity of changing social custom, and without government interference, can increase his farm business income most. The changes suggested under this head can all be carried out by the individual, without the necessity for community or Government action. There does not seem to be any undesirable social effects of this method of increasing the farm business as there seems to be with some other methods.

Increasing the Farm Business by Improving the Efficiency of Live Stock.

India has a large livestock population which must be maintained on the land In many cases, this live stock does not contribute to the farm income as much as it should. Many communities keep buffaloes to produce milk and butterfat, oxen (bullocks) to do the farm work and cows to produce the bullocks. Many animals produce little if anything beside their hides and bones and the conversion of grass into dung for fuel. For the return, the cattle population is excessive and food is lacking to keep them all. Their value to the farm enterprise can be greatly increased by better feeding and by the combining of functions in one animal which are now distributed in several.

The ordinary holding can now support one pair of animals. Since work animals are essential if the farm is to go on, they are the first animals kept. They are usually inadequately fed and often under developed due to semi-starvation during the growing period. Better cropping and soil management practices will provide more food through increased production. Better methods of storing and utilising the food, particularly the roughage, will further improve the value of the feed produced. For this, the silo is particularly desirable.

There are several combinations of function which can reduce the necessary number of animals to be kept. Good cows are as efficient in converting food into milk and butterfat as are buffaloes. If instead of buffaloes, cows are kept, they will produce both milk and bullocks. This reduction in animals will leave more food for the remaining animals. Of course, it is necessary to have good animals with good feeding and controlled breeding to maintain and improve the quality of the animals.

It is possible to still further combine functions by using the milking cows as the work animals. This is done on farms in Eastern Europe. With improved implements, the work on the smaller holdings and even the enlarged holdings suggested in the preceding parts of this article, will not require the full time working of the animals. Swiss tests have shown that four hours a day work does not affect the milk yield of heavy milking cattle. It seems likely that a pair of the better Indian milking cows can do all the work necessary on a farm of 15 acres and still give all the milk they are genetically capable of giving, if they are reasonably well fed. This should make possible the reduction

of the number of animals now maintained by 50 per cent leaving an adequate fodder supply for the remaining population. While there is religious prejudice against this arrangement, there does not seem to be any religious prohibition of it in any of the scriptures.

Where religious scruples do not interfere, it may be possible to increase the farm business by the keeping of sheep, fowls, goats, pigs, rabbits or other small animals for eggs, meat, wool or fur, or other products. These may be used for the farmer's own food supply or sold. Often a few fowls will produce relatively a large income.

Other Ways of Increasing the Farm Business.

Two sub-headings remain in our list of ways of increasing the farm business, "Increasing the non-human power per farm worker" and "Developing a well integrated and co-ordinated system of farming." The first has been discussed by the author of this paper in other places and will be referred to in the following article on this series on "The Co-operative Farm." The second is too long to discuss here but will be discussed in a fourth article concluding the series. Up till now, agricultural research men and educators in India have largely devoted themselves to piecemeal improvements—the development of a new or improved strain of a crop or of a single new implement. The time has now come when more attention should be given to the co-ordination of efforts toward the development of *systems of farming*, with the attempt to find out what is the limiting factor in any system that seems desirable and the concentration of effort toward improving or correcting that factor to make the system feasible. To do this, we must decide what we want to promote, what is socially desirable and technically feasible under existing conditions. We should then concentrate our efforts on making what we consider desirable and feasible as "economic" as possible. We need "planning" of the right type in Indian agricultural improvement.

Because of the conditions indicated in the first part of this paper, we must choose between (1) relatively small farms and (2) a very small percentage of the population in agriculture. The average size cannot be large with the existing population and the restricted area available, if we have any considerable percentage of the population in agriculture.

Agriculture is the one remaining occupation in which the individual can exercise his individual ingenuity and work alone. The family size farm has human personality values that are valuable and should be conserved. For this reason, I believe that plans for agricultural and industrial development should be made on the basis of not less than 25 per cent. of the population remaining in agricultural production. On the basis of family farms and 25 per cent. of the population in agriculture, the average size of holding could be of the order of 3 times the present holdings for the present population. Of course, there will be variation unless the size of holding is limited by law. Where conditions are particularly favourable, there will be a tendency to subdivide the land into smaller holdings; where conditions are less favourable, it will be necessary to have larger holdings to get the same income. It may be possible that for some types of farming, in which I mean to include fruit growing, dairying and cattle breeding, we will have to have larger areas in each unit. Before we accept or assume the necessity for such larger units, it would be well to examine very carefully what factors we think make large units necessary. It may be possible to change the limiting factor by research. So much of what we do is the result of habit, empirical and not based on any compelling necessity. The implements and machines we use are so often the result of accident, so far as size is concerned. So little of our agricultural practice has been established by controlled research that almost any practice now in use may be questioned.

If we decide that a certain average size of cultivation unit is the most practicable, or socially the most desirable under existing conditions, the way to maintain or to establish that as the common unit is to make that unit economically feasible or desirable. I doubt the advisability of any reform which must be brought into effect largely by compulsion. While there are undoubtedly ignorant and unintelligent farmers, by and large farmers will adopt those practices, crops and implements which are demonstrated to be useful and desirable technically and economically. If compulsion is necessary to introduce a new practice, crop or implement, it is probably undesirable. If it is good, demonstration of its value will be enough. I am entirely opposed to the type of planning which results in "leaders" deciding what is desirable and then applying compulsion to bring it into effect. I am entirely in favour of that type planning which studies all phases of a question or situation, finds out the apparent necessities, applies research and knowledge to the solution, of difficulties and makes public the results. I believe in democracy in economic matters as well as in politics. If it is true that, given knowledge, the judgment of the people can be trusted in political matters, it is also true that, given knowledge and help, the farmer can be trusted to adopt those practices, crops and implements which give the best results. If he does not adopt them voluntarily, there is immediate doubt about their value.

While the farmer can and should be trusted to adopt what fits his needs when it is brought to his attention, he does not always know what he needs most nor has he the knowledge to reason out what he needs or how to solve his difficulties. It is the job of the scientist to study the farmer's needs *with him*, to find out the bases of changes needed and to work out for him the procedures, practices, crops, animals and implements needed to make the existing or practicable holdings economic. These findings must be made known to the farmer. If he then does not accept them, the first thing to look for is the remaining defect or weakness in the supposed improvement.

Mr. Mosher discussed the impropriety of trying to artificially determine the "economic unit" for the family size farm. The article points out that the *area* of the farm is one of the factors determining the earning power of it but that it may not always be possible or socially desirable to determine the desirable size of farm on the basis of its earning power. It was also pointed out that various other methods beside the increasing of the area may be adopted to increase the size of the farm business. The earning power of the farm may depend more on how it is managed than on its size.

The next article will deal with the co-operative farm and with some of the difficulties commonly overlooked by its advocates.

Only about 11 per cent of the earth's total land area, whether it be in the hands of our enemies or our friends, is capable of cultivation now or in the immediate future. This relatively small fragment of earth is all the human family can draw upon. At present, the other 89 per cent cannot furnish man with the necessities of life . . . Today the world faces a scarcity of productive soil. Some 2 billion people depend for sustenance on only 4 billion acres.—[*Agrl. Missions Notes.*]

NOTES ON FUNGI AND THE WEATHER AT ALLAHABAD

By

E. F. Vestal,

Allahabad Agricultural Institute.

Weather data collected at the Allahabad Agricultural Institute show that the kharif (rainy season) crop season of 1945 was unusual for that area. Humidity, rainfall and temperature data collected at the Agricultural Institute for the 1945 season are shown in Table No. 1. Certain fungi, normally considered as only saprophytic, were especially active during the latter part of August and September, whereas other fungi normally present were conspicuously absent. Unfortunately, very few data on the behaviour of fungi in this area during the previous five years are at hand so that there are no comparable observations available as standards. The object of these notes will be to show possible influences of the weather upon the activity of fungi observed on the farm in 1945 kharif season.

The data collected by the Institute weather station during the kharif season of 1945 are shown in Table No. 1 and for the same period for the years 1940 to 1944 inclusive in Tables No. II, III and IV. The rainfall is given as total rainfall in inches, the humidity as the average per cent and the temperature as average degrees F. In Table No. 1, the data are for weekly averages and in Tables Nos. II, III and IV in terms of monthly averages. Figure No. 1 graphically illustrates the weekly rainfall, humidity and temperature for the kharif season of 1945.

It will be observed that the rainfall for the kharif season of 1945 was lower than for any of the previous five years. A comparison of the total monthly rainfall of the 1945 season with the six-year average (see bottom line of Table No. II) will show that only in August and October was there more rain in 1945 than in the six-year average. In August there was a difference of only 0.08 of an inch but there was nearly three times the six-year average rainfall in October, 1945.

A glance at the humidity data in Table No. IV will show that the humidity for 1945 was consistently lower than for the six-year average. It wss an average of 15.59 per cent and 15.18 per cent lower in the months of July and August respectively. Differences for the other months were not as great but they show that the humidity of the season was lower than normal.

Table No. I.

Weekly Rainfall, Humidity and Rainfall Data for the Period June 26 to Oct. 27, 1945. Collected at Allahabad Agricultural Institute.

Period.	Total Rainfall in inches.	Average Humidity in per cent.	Average temperature in degrees F.
June 26—30	1.21	53	84.3
July 1—7	1.44	55	86.3
July 8—14	1.44	58.4	86 8
July 15—21	6.62	65.4	84.1
July 22—28	1.15	63.8	86.4
July 29—Aug. 4 ..	2.9	58	84.5
Aug. 5—11	0.0	66	89.1
Aug. 12—18	6.89	72 1	84.5
Aug. 19—25	1.86	73.8	83.2
Aug. 26—Sept. 1 ..	1.08	77.4	81.4
Sept. 2—8	0.87	76.1	83.7
Sept. 9—15	1.92	83.3	81.9
Sept. 16—22	0.12	75.7	81.8
Sept. 23—29	0.0	69.4	83.6
Sept. 30—Oct. 6 ..	1.10	73.4	78.8
Oct. 7—13	0.28	74.0	77.7
Oct. 14—20	0.12	75.5	76.8
Oct. 21—27	1.45	79.1	70.4

As might be expected, with low rainfall and humidity, the temperature would remain high. Table No. III contains the average monthly temperature data for the six-year period 1940 to 1945 inclusive. The greatest difference in temperature between the 1945 season and the six-year period was during the month of August when the average temperature was 3.37 degrees above the six-year average. The 1945 season was different from that of any of the other years under consideration. The temperature for the years 1940 to 1944 inclusive dropped from June to August, whereas in 1945 this was not true. There may have been some fluctuations, as in the case of 1944, but in each year the temperature for August was lower than that for June of the same season. The temperature for August in 1945, was actually higher than for June and there had been a steady

rise in temperature for the entire period. Figure No. 1 shows the fluctuations for the period.

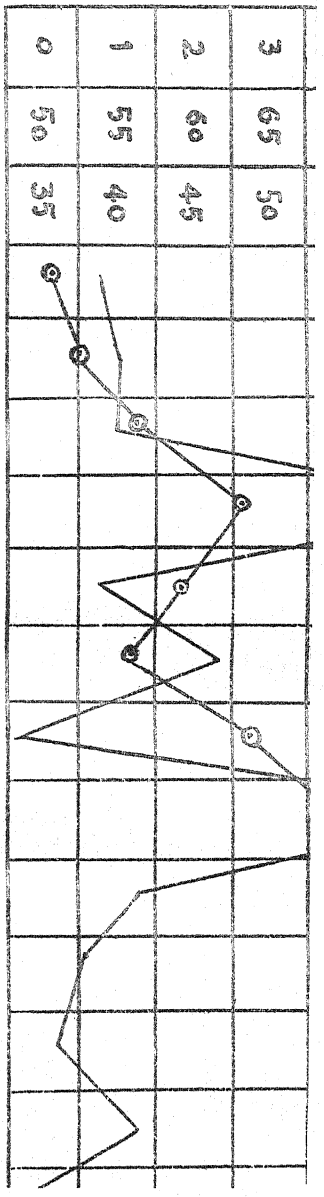
Many of the common plant diseases appear to respond to changes in humidity more readily than they do to direct rainfall. Although there was relatively heavy rainfall during short period in July and August, the humidity did not reach as high as 70 per cent until the third week of August, after which it rose steadily until the second week of September, when it reached the season's high point of 83.3 per cent. But it dropped quickly so that the average for the month was 3.69 per cent below that of the six-year period.

During the period of June to September in 1945 there was less activity on the part of the usual leaf spotting fungi than in other years. The abnormally high temperature and the low rainfall and humidity no doubt acted as a check on the spread of such fungi as *Cercospora*, *Phyllosticta* and others. In the Allahabad Agricultural Institute area there was not enough activity on the part of these fungi to provide material for class study, although there was an unofficial report that sann-hemp in the Benares area was being damaged by a species of *Cercospora*. During the second week of August, 6.89 inches of rain fell and the temperature began to drop, with a corresponding rise in humidity.

Among the fungi normally saprophytic, but found at times mildly parasitic, are species of the *Choanephora*. They are usually found on the petals of the flowers of bhindi (olera), brinjal, *Cucurbitaceae*, occasionally on some of the legumes, such as a *Crotalaria*, and similar fleshy petaled plants. But in 1945, *Choanephora* was observed on a number of other plants in addition to the ones mentioned above. Among these were guara (cluster bean), alfalfa, ground nuts, *Amaranthus* species, *Hibiscus* species, castor bean and wheat seedlings. These infections were leaf and not petal infections. In the case of the *Amaranthus* species, in the variety garden, scarcely a leaf remained which was not damaged and many were completely destroyed. On the castor bean plants many leaves were damaged. In some cases the entire leaf was rotted. Only sporangiophores of *Choanephora* could be seen when examined under the microscope. During the period of greatest damage (the first two weeks of September) the temperature ranged between 81 and 83 degrees and the humidity between 76 and 83 per cent. In the case of bhindi, many fruits were damaged. In some cases the fruit was rotted so that it fell off. On the wheat seedlings in the field a species of *Choanephora* was found and isolated which has the general appearance of *Choanephora cucurbitarum* (Berk. & Rav.) Thaxter. It is believed that this is the first time *Choanephora* has been observed on a cereal in this area.

Two of the common leaf spotting fungi, *Cercospora cruenta* Sacc. and *C. personata* (B. & C) Ell. & Ev., which are usually abundant in September, did not appear until the first of October and the latter fungus was seen on only a few leaves during that month. By October, when the temperature had dropped to below 80 degrees and the activities of the *Choanephora* had declined, the mung plants (*Phaseolus radiatus*) were attacked by *Cercospora cruenta*. There was a steady drop in the temperature throughout October until by the 27th it had fallen to 70.4 degrees and the humidity stood at 79 per cent. The mung plants were severely damaged by the *Cercaspora*, complete defoliation having taken place, but it is doubtful if the damage to the ground nuts up to the end of the month of October would be as much as one per cent. Although there are no data from previous years to use in comparison, Tables Nos. II, III and IV will show that in no previous season did such a combination of rainfall, humidity and temperature occur.

The lowering of the temperature in October, with the corresponding rise in humidity and heavy rainfall, created a favourable condition for such fungi as *Pythium*, *Rhizoctonia*, *Fusarium*, *Sclerotium* and other soil borne pathogens which are commonly found on the root systems of the field crops. By the 15th of



6-year average	54.25	76.24	82.65	76.2

ture for the entire period. Figure No. 1 shows the fluctuations

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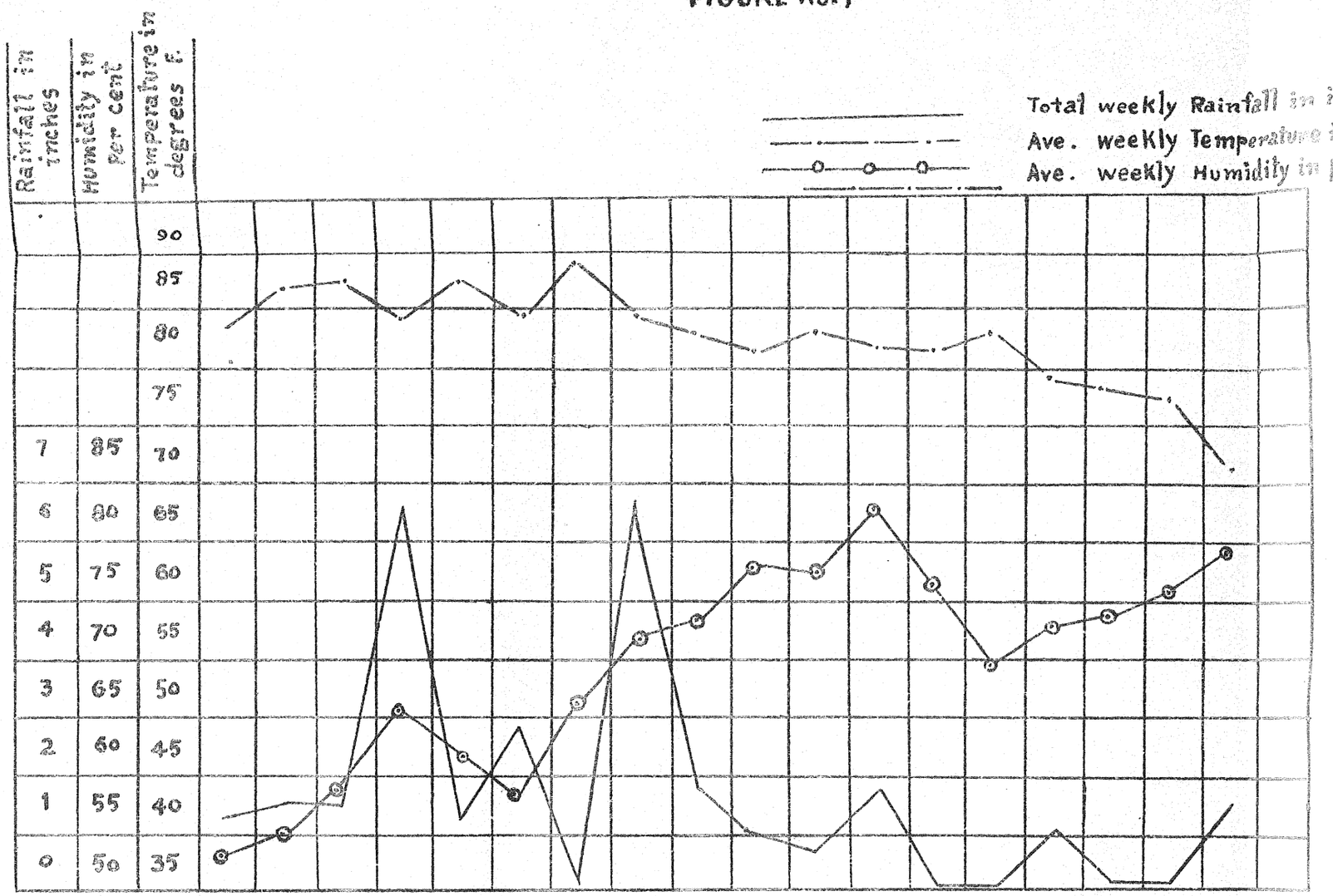
Rainfall in inches
Humidity in per cent
Temperature in degrees F.
Total weekly Rainfall in inch
Ave. weekly Temperature in d
Ave. weekly Humidity in per
90
85
80
75
70
65
60
55
50
45
40
35
7
6
5
4
3
2
1
0
85
80
75
70
65
60
55
50
45
40
35
June 26-30
July 1-7
" 8-14
" 15-21
" 22-28
" 29-31
Aug. 1-4
" 5-11
" 12-18
" 19-25
" 26-31
Sept. 1
Sept 2-8
" 9-15
" 16-22
" 23-29
" 30
Oct. 1-6
" 7-13
" 14-20
" 21-27

Pythium, [illegible]
are commonly found on the root systems of [illegible]

TABLE No. II.

Monthly Rainfall in Inches for the Years 1940 to 1945 inclusive, for the Months of June to October inclusive, Allahabad Agricultural Institute Farm.

Year	June	July	August	September	October
1940	0.80	4.87	14.72	5.60	0.19
1941	2.74	5.72	5.28	8.65	0.04
1942	4.52	7.10	9.98	8.22	0.00
1943	0.89	8.29	19.78	8.78	0.74
1944	1.09	8.64	19.04	4.98	2.08
1945	1.21	5.62	11.65	2.91	2.97
6-year average	1.86	6.62	11.57	6.52	1.00

TABLE No. III.

Average Mean Temperature for the months of June to October inclusive for the years 1940 to 1945. Data collected at Allahabad Agricultural Institute Farm.

Year	June	July	August	September	October
1940	93.72	83.38	83.19	83.45	80.50
1941	89.60	86.40	83.70	83.20	80.10
1942	94.34	83.75	82.38	81.22	78.50
1943	92.88	85.63	80.80	83.50	76.84
1944	82.65	86.95	81.33	79.45	74.62
1945	84.30	85.90	86.32	82.75	75.92
6-year average	89.25	85.33	82.95	82.34	74.39

TABLE No. IV.

Average humidity in per cent for months of June to October inclusive for the years 1940 to 1945 inclusive. Data collected at Allahabad Agricultural Institute Farm.

Year	June	July	August	September	October
1940	48.30	78.00	83.70	73.50	58.00
1941	63.56	70.36	83.70	83.20	80.10
1942	49.08	86.24	79.25	79.52	76.08
1943	56.89	72.60	93.24	88.00	86.95
1944	54.70	89.60	88.55	78.76	78.86
1945	53.00	60.65	67.47	76.12	75.50
6-year average	54.25	76.24	82.65	79	76.25

October wheat seedlings in the early plantings were observed dying. The first appearance of the symptoms was a graying of the leaf tips and a wilting of the whole plant, followed by yellowing and dying. Examination of the root systems in the various stages of disease disclosed infected areas on the roots of the plants showing the early disease symptoms and, in many cases, completely destroyed root systems of those in the last stages. From roots in the early stages of disease a *Pythium* was isolated and from the later stages a *Rhizoctonia* was commonly isolated. Cultures of these fungi have been turned over to Dr. R. K. Saksena of the Botany Department of the University of Allahabad, who has kindly consented to study and identify them.

Using sterilized soil and the same variety of wheat (X—9) as that from which the isolations were made, preliminary trials to determine pathogenicity have been run. When *Pythium* was used alone the emergence was reduced approximately 10 per cent. When *Rhizoctonia* was used alone emergence was reduced about 6 per cent; but when both were used together emergence was reduced about 25 per cent, which compares favourably with the loss estimated to have occurred in the field.

Other pathogens which sprang into prominence with the cool weather were root rotting fungi on the young papaya trees. So far at least one, and perhaps more, species of *Fusarium* has been isolated from the rotting papaya roots and in a number of cases a species of *Rhizoctonia* has been found associated with the diseased condition. Steps are being taken at this time to determine pathogenicity of the fungi. Barley plants found dying in the field plots have yielded a species of *Helminthosporium* and *Sclerotium rolfsii* from the diseased roots.

In the absence of any correlated data regarding the effects of weather on the behaviour of the various soil borne plant pathogens it appears that this field should be one on which some time and effort may well be spent. From work being done in other parts of the world it may safely be assumed that such a study would yield extremely valuable data useful in a programme of disease control.

"There is enough to do, and more, to tax the skill and ingenuity, the strength and resources, the courage and faith of us all in a measure perhaps as great as in the war. And we in agriculture know this too, that, as the Maoris put it, 'The land is the mother of us all; the land is the mother that never dies.' Yes, under all, the land; but on the land, the people."

E. De S. Brunner,
Professor, Columbia University, U. S. A.

A BRIEF REVIEW OF RECENT OBSERVATIONS REGARDING SOIL MICRO-ORGANISMS

By S. Chowdhury

I.—Introduction.

Through the years, the original concept of the soil population as predominantly bacterial has been modified to include a host of other individuals found among the actinomyces, filamentous fungi, alagae, protozoa and other tiny animal organisms. By means of observing micro-organisms in the soil directly with the microscope, as provided by the technique of Conn, it has been shown that the small, non-sporulating bacteria predominate and that the larger spore-forming types occur in relatively small numbers except under special conditions (14, 36, 95, 96). The abundance of bacteria in fertile soils is now calculated in the tens and hundreds of millions per gram, in contrast to a few millions by the plate method. Any attempt to convey definite information about the range in numbers of micro-organisms in various soils is not likely to be satisfactory. Despite numerous quantitative studies the results reported fail to give us a clear picture, largely because of differences in the methods and procedures employed. Despite the limitations of the various methods, it is apparent that the inherent characteristics of the soil and the practices of soil management exert pronounced effects on the abundance of the microbial population as a whole and upon the relative abundance of the various species.

New revelations of the habits of growth of soil organisms have been disclosed by the use of the contact slide method developed by Rossi and Cholodny (13, 16, 19, 35, 72). This technique indicates the tendency of bacteria to grow in colonies and to develop in local masses in the vicinity of available food materials. The profuse filamentous development of fungi is evident, and sporulation is at times detected. Actinomyces appear as branched filaments and fragmentation into conidia is readily seen. The digestion of fungous filaments by bacteria and actinomyces is also apparent as one group of organisms succeeds another (23, 101). The soil microscope of Kubiena is particularly valuable in studying the development of the larger soil micro-organisms about the soil particles and determining the influence of moisture content, aeration and various other external conditions upon successions of members of the soil population (46-49.)

Those who have made use of the direct microscope methods seem almost unanimous in their agreement that, while the methods are of great value in studying the soil organisms, they should not be considered as substitutes for the commonly used plating methods and other procedures but rather as additional methods to be used to complement the others.

Winogradsky has successfully used enrichment soil cultures and selective silica gel media for studying in nitrogen-fixing bacteria, cellulose-decomposing bacteria and nitrifying bacteria (97-100).

Koffman also found direct microscopic study particularly valuable for investigating the soil protozoa (43). He noted that unlike conditions in water bodies, tiny flagellates are the most abundant and active protozoa in the soil and that they are not important consumers of soil bacteria. His observations add further weight to the opinion that partial sterilization phenomena are not directly associated with the protozoa in their effects on plant growth.

Various methods have also been devised for estimating the fertility of soils and for detecting deficiencies in soil nutrients. Among these should be mentioned the *Azotobacter* soil plate method developed by Winogradsky, which has proved useful for detecting phosphate deficiencies (95-97, 100) and the *Cunningh-*

mella method of Mehlich, Fred Truog developed along similar lines (57). The growth of *Aspergillus niger* for detecting soil requirements for potassium has been used extensively by Niklas and his associates (58, 65). Conn has recently made use of an organism called *Bacterium globiformis* as an indicator of soil conditions (15, 17). These methods are all based on the use of micro-organisms as test plants, and the assumption is made that the rapidity of their development are determined by the abundance, in available form, of the specific nutrient under consideration. As yet the methods have had rather limited application in practical soil tests, but their adoption may be no accurate criterion of their usefulness.

II.—Pathogenic Micro-organisms.

It is now definitely established that many organisms pathogenic to man are of soil origin, that they may survive in the soil for long periods of time and that contaminated soils are able to spread infection. Rhines has recently reported that certain tubercle bacilli survive for many months and may even multiply in this soil environment (71). Schalk and his associates found that fowls become infected from litter and soil contaminated with tubercle bacilli as as long as 4 years after the original introduction of the organisms (75). It is indeed fortunate that most animal pathogenes diminish in numbers when they are incorporated with the soil. The control of certain animal diseases would be very difficult if the pathogenes retained their viability in infected soil. The pathogenic organisms which do persist in the soil are represented by anthrax, black leg, coccidiosis and others. The persistence and development of organisms pathogenic to higher plants have always been a serious agricultural problem.

III.—Environmental Conditions

Temperature.—There is much information in our literature on the general relation of temperature to the growth and activities of micro-organisms but most of the results are concerned with specific organisms raised in a specific medium. Some observations made by Mishustin are particularly interesting in view of their indication that micro-organisms developing in their soil habitat have the capacity of making certain adjustments to climatic conditions (61). A comparison of optimum and maximum temperatures for soil bacteria shows that there is a ready response to temperature changes. There is a direct relation between mean and annual air and soil temperatures, on the one hand, and optimum temperature conditions for growth and development, on the other.

The optimum temperatures for soil bacteria are considerably higher than those which prevail in the soil even in summer. In view of this, it may be assumed that there is utilized by the micro-organisms only a part, at times only a small part, of the potential energy resources. As we pass from south to north, the coefficient of such energy utilization tends to decrease.

Mishustin's observations find confirmation in the work of Jenny. As he expresses it "Within regions of similar moisture conditions the nitrogen and organic matter content of upland terrace and first bottom soils, including both prairie and timber vegetation decreases from north to south" (33). If the data on which Jenny bases his conclusions are correct, we should be justified in concluding that, as we proceed from south to north, the available microbiological energy resources in the soil are used to a decreasing extent. There is room for productive work on the temparature micro-organisms relations in respect to latitude and altitude, with other major factors remaining the same. There are indications that under the prevailing high temperature conditions of the tropics microbiological activities may be modified in a very substantial manner. Thus

Dhar and his associates have claimed that in tropical countries temperatures may be too high to permit biological nitrification (82). Data are offered by these workers and Corbet to justify the assumption that photo-chemical oxidation predominates in such soils. According to Fraps and Sterges (25) however, light does not favour the nitrification process in soils under the conditions existing in Texas. Jensen recently observed that the numbers of bacteria and fungi increase with the moisture content without being appreciably influenced by the temperature (34) The proportion between bacteria and actinomyces decreased with decrease in moisture.

Salts :—Further confirmation of the conception that the environment may alter, to some extent, the characteristics of the individual members of the population is found in the observations of Baars (5). Using sulphate-reducing bacteria, he was able to train cultures of a fresh-water form to grow at high salt concentrations. He also accustomed a halophilic form to develop at low salt concentrations. Furthermore, a culture of a thermophilic organism which grew best at 55°C was so treated that it grew better at 30°C than at 55°C. It was concluded that the three cultures were the same species, but that the natural environments had altered their ability to tolerate certain temperatures and salt concentrations. In an extensive study of bacteria belonging to various physiological groups Hof demonstrated that considerable alteration in the tolerance of strains of bacteria to various salt concentrations could be achieved by cultivating the organisms in selective media (31). He stated ".....some common soil bacteria possess the ability to adapt themselves to the life in salt containing media and in doing so lose the property of development under the conditions of the original environment (31)." "From the results obtained it may be concluded that in fact it is possible to isolate from salt-free material forms which have adapted themselves in such a way to a life in a salt environment that they do not develop subsequently in media without salt. Therefore, it is very probable that many, if not all forms occurring in natural brines are adaptation forms from 'normal' soil bacteria" (31). Soil conditions must continually exert selective influences upon the microscopic inhabitants favouring the persistence of those strains or varieties which are best suited to development in the particular environment.

Certain heavy metals and other inorganic ions not generally considered to be plant nutrients exert specific effects upon plants or soil substances, some favouring plant development and others having toxic effects. In some soils occurring in regions of deficient rainfall in the United States selenium occurs in sufficient abundance to be toxic to plants and to render the plants poisonous. It has been found that sulphates reduce the absorption of selenium by the plants (32). Furthermore, certain fungi appear to be able to decompose insoluble and non-volatile selenium compounds with the release of offensive gases much the same as occurs with arsenicals (42). Treatment of certain raw peat soils with copper salts has resulted in pronounced improvement in plant development (2). Zinc sulphate has proved effective in controlling a condition of bronzing of tung trees (62) and cholorosis of corn plants (7). Similar results have been reported by the California Experiment Station in connection with the treatment of chlorotic citrus trees with zinc sulphate (29, 68). It is still to be determined whether the influence of zinc and some other metallic ions is a direct one or whether it is exerted indirectly through chemical and microbiological changes produced in the soil.

Moisture :—Extreme desiccation has been long known to kill vegetative cells of many bacteria. McLennan even developed a method for determining the abundance of vegetative fungous growth in soil based upon the destruction of this growth by drying (55). However, many bacterial cells appear to persist in the absence of appreciable amounts of moisture. Brown found that most bacteria remain viable without being transplanted for many years when rapidly

dried on small bits of filter and kept under reduced pressure (9). It has further been noted by Lipman that bacteria are able to persist for long periods of time in dry soils, rocks, coal, mud, bricks and adobe bricks (50, 51). Such persistence of micro-organisms under extremely adverse conditions insures their wide distribution and their survival in spite of periodic changes in moisture content, temperature, and even reaction.

Reaction :—The influences of soil reaction upon certain soil organisms are also readily detected. It has been noted frequently that the proportion of filamentous fungi to bacteria and actinomyces is greater in acid soils than in those close to neutrality (34). Many observations have been made that cells of *Azotobacter* are encountered in relatively small numbers in soils more acid than ph. 6.0 (26). It also appears that at least certain cellulose-decomposing bacteria are injuriously affected by similar acid conditions (22). In the absence of the host plant various species of *Rhizobia* persist for longer periods in greater numbers in soils which are close to neutrality than in distinctly acid soils (94). Various fertilizer treatments likewise favour their development (52, 92). Alway and Nesom found that the soil transfer method of inoculating acid soils for alfalfa was more effective than inoculation with pure cultures (4). This suggests that some of the characteristics of legume bacteria may be affected by the soil conditions.

These and numerous other studies indicate that the environmental conditions not only affect the relative abundance and distribution of types of micro-organisms but also may exert some influence upon their physiological behaviour.

Aeration :– It has been clearly demonstrated by plant physiologists that the development and activities of plant roots are greatly affected by the concentration and rate of supply of oxygen in the soil environment. Loehwing (53) states that improper composition of soil air manifests itself in reduced slow growing root systems, inadequate absorption, short-lived, discoloured foliage and delay or failure of reproductive processes. The symptomatic complex arising from impaired gas exchange of roots reflects a general reduction in rate and magnitude of normal absorptive and growth processes. The great bulk of existing evidence thus indicates that roots are sensitive to variations in soil air.

As shown by Cannon and Free (11) roots of plants differ in their requirements for oxygen but all require at least small amounts. Some species of bog plants and even barley can tolerate as low an amount as 0·5 per cent of oxygen in the gases, at least for a time, whereas others require as great an amount as 10 per cent. The factors of diffusion rates and temperature are closely related to the effects of various gases on root development and plant growth but no less important is the part played by micro-organisms in altering the ratios of oxygen to carbon dioxide. Although we know in a general way the factors affecting oxygen consumption and carbon dioxide production by micro-organisms in soils there is still much to be learned regarding the influences exerted by micro-organisms upon root development through modifications in the soil gases.

Organic Matter :—Among the various factors affecting soil organisms certainly the influence of organic materials is one of the most important. Recent reports by Jensen (34), Brown and Benton (10) and Gray and McMaster (28) indicate that the principal factor responsible for the variation in abundance of micro-organisms in different soils and at different depths of the soils, is the nature and amount of the organic matter. Soil reaction is a factor of secondary importance. Studies to explain the reactions involved following the introduction of organic substances into soils, studies of the organisms concerned in the transformations, and the influence of the products upon soil conditions and plant development have commanded some of the best efforts of soil scientists. It is now obvious that most of the decomposition is effected by micro-organisms and

that many groups of specific forms are concerned in the attack on the numerous compounds contained in plant and animal products. Some of the plant residues are more resistant than others and it is the more resistant compounds combined with certain microbial products which characterise the organic matter in soils. According to Waksman this material having a relatively high caution-absorbing capacity is largely composed of lignin derivatives combined with appreciable amounts of protein materials (89). It is due to this combination with lignin that the organic nitrogenous substances owe their resistance to decomposition. In such combinations they are but slowly attacked whereas uncombined they are quickly decomposed. There are many factors concerning the transformation of lignin in nature that are still obscure and call for an explanation. It seems likely that aerobic conditions are particularly favourable to its destruction and that the accumulation of large deposits of plant wastes has been possible mainly because of the anaerobic conditions under which the materials were originally laid down (86, 87-91). The effective utilization of organic matter in soils depends upon the control of the processes of decomposition and accumulation, favouring the mineralization of the nutrients bound up in highly organic soils and leading to the accumulation of greater quantities of organic matter in soils deficient in humus, particularly soils of warm climates.

IV.—Interrelations between Higher Plants and Micro-organisms

As higher plants develop in soils many microbial activities are accelerated and the seat of most intense activity becomes localised as also happens after additions of organic materials. Extensive development of micro-organisms occurs in the rhizosphere, starting while the plants are still young and continuing throughout the periods of active plant growth. These effects are the results of modifications of the soil environment through physical and chemical changes caused by the roots. The most pronounced influence is no doubt exerted by organic substances coming from the roots themselves (27, 54, 70, 81, 83.) It is in the rhizosphere that the soil plays its important roles, in the nutrition of the higher plants. It is here that the influences of symbiosis, mutualism, stimulation, toxicity and inhibition become particularly impressed upon the plants. Micro-organisms in the rhizosphere may thus favour the assimilation of nutrients by plants and probably also exert equally injurious effects under certain conditions.

There is evidence of a revival of interest in soil inoculation, based upon the opinion that the organic root excretions are able to support sufficient growth and fixation of nitrogen by *Azotobacter* to satisfy the nitrogen requirements of the plants. Such studies were originally made by Truffant and Bezssonoff with maize and have been extended by several Russian workers who conclude that many plants such as tobacco, maize and cotton make appreciably greater growth after inoculation with *Azotobacter* (12, 30, 39, 44, 76-80, 85). These results have not been verified by all students of the problem, and there is evidence to indicate that *Azotobacter* does not appear more commonly in the rhizosphere than elsewhere in the soil (68, 18, 20, 52, 70, 67, 92).

V.—Antibiotic Phenomena

The effects of one organism upon the development of another are in many instances so difficult to isolate and demonstrate that comparatively little is known of these relationships which may be of considerable importance in soil processes. Our studies of known cultures have often given a distorted picture of what actually happens in the soil environment. Some highly suggestive results have been obtained by plant pathologists and others concerning the relations between certain organisms considered to be soil saprophytes and organisms which invade plant tissues. Sanford studied the possible antagonistic action of soil bacteria

to the actinomyces causing potato scab. He suggested that the control through addition of organic matter might be explained in part at least through the inhibiting effects of the bacteria which developed upon the green manures (73). He succeeded further in demonstrating that some soil fungi and bacteria suppress the pathogenecity of the wheat root rot fungus and concluded that antibiotic effects among the soil inhabitants may be very common (74). Johnson (37) and Bamberg (6) obtained bacterial cultures which were not only able to overgrow the smut fungus of maize but also inhibited development of the fungus in soil and exerted pronounced control of the infection of the maize plants. Tims isolated a number of actinomyces which inhibited growth of a *Pythium* root parasite of sugarcane and reduced infection through toxic substances which were produced by the actinomyces (84).

Weindling obtained striking results with *Trichoderma lignorum* which inhibited the development of several parasitic root fungi and prevented root infections in soils (93). It has been observed more recently by Allen and Haenseler that the *Trichoderma* exerts its influence through materials which are toxic to the parasitic fungi (1).

Other results of a similar nature have been obtained with many organisms, some parasitic and some saprophytic (69). Melin observed that certain species of *Torulopsis* depressed development of fungi, causing blue staining of wood, pulp and considered their use for controlling pulp staining in the mills (59, 60). In forest nurseries certain organisms are used for a somewhat different purpose. The nursery beds are frequently steamed to kill 'damping-off' fungi. Seedlings frequently grow poorly in this steamed soil and it has been found that if the beds were inoculated with some of the prevalent forest nursery soil fungi and bacteria, the seedlings develop better than in either untreated or steamed beds which are not inoculated (66).

Very often higher plants affected by disease appear to be greatly influenced by soil conditions and the general activity of the microbial population. Cotton root rot is particularly severe in certain soils of low fertility (24). Fertilization with suitable quantities of nitrogenous and phosphatic materials and improved cultural practices show promise of greatly reducing the severity of the disease and of providing effecting means of control (40, 56, 63, 64). In this connection Jordan, Dawson, Skinner and Hunter conclude (38), " Evidence is presented to show the importance of the appreciable acceleration of maturity effected by favourable fertilizers in most of the experiments as a means of evading losses of crops due to progressive killing of plants by root rot." It is further noted (38) that the direct effect of fertilizers while of insufficient magnitude to be of economic importance *per se* is highly significant as reflecting the influence of soil fertility in general and of the use of fertilizers on the effective virulence of the root rot disease. It also implies that the continued use of appropriate fertilizers in successive years, together with the application of other measures designed to restore or maintain fertility may eventually lead to material control. The treatments were also frequently characterised by enhanced activity of the soil organisms other than the root rot fungus and it has been suggested that this may also be concerned with suppression of the disease (23, 41.)

Still another relationship appears between micro-organisms in an extension of the observation that bacteriophage active against legume bacteria may occur in the root nodules. Demolon and Dunez consider that the phage lowers yields of alfalfa and causes the decline and failure of alfalfa after a few years (21). On the other hand, Almon and Wilson failed to note any significant effect of bacteriophage on growth and nitrogen-fixation with red clover (3), and Laird found bacteriophages of common occurence in nodules of many legumes. Laird (3) stated : "Thus one may safely conclude that a lytic agent is carried within all nodules in the early stages of growth at least."

There is thus opened a new field of study and perhaps of application. Only as the influences of varicus organisms on one another are understood and the extent of the operation of their effects in soils is known can there be any real appreciation of the associative development of micro-organisms in such a complex environment as the soil. The soil toxin theory of Whitney, Schreiner *et al* has found little support in the results of investigations of recent years, but in its place there have appeared many new explanations of observed differences. Some of these are based upon biological soil factors and some on strictly chemical and physical soil characteristics. Experience has shown that soil deficiencies cannot be ascribed to a single factor but that new problems are continuously arising which find their solution only in hitherto unexpected relationships.

LITERATURE CITED

(1) Allen, M. C. and Haenseler, C. M. (1935) *Phytopath.* **25** : 244-252.

(2) Allison, R. V., Bryan, O. C. & Hunter, J. H. (1927) *Fla. Agri. Exp. Sta. Bul.* **190.**

(3) Almon, L. & Wilson, P.W. (1933) *Arch. Mikrobiol.* **4** : 209-219.

(4) Alway, F. J. & Nesom, G. H. (1927) *Minn. Agric. Exp. Sta. Tech. Bul.* **46.**

(5) Baars, J. K. (1927) Over Sulfatreductie Door Bacterien Dissertation at Delft, Holland.

(6) Bamberg, R. H. (1931) *Phytopath.* **21** : 881-890.

(7) Barnette, R. M & Warner, J. D. (1935) *Soil Sci.* **39** : 145-159.

(8) Batchelor, H. W. & Curie, I. H. (1931) *Ohio Agric. Exp. Sta. Bul.* **470.**

(9) Brown, J. H. (1931) *Science* **74** : 391-392.

(10) Brown, P. E. & Benton, T. H. (1930) *Iowa Agric. Exp. Sta. Res. Bul.* **132.**

(11) Cannon, W. A. & Free, E. E. (1925) *Carnegie Inst. Wash. Pub.* **268** : 1-168.

(12) Caron, A. V. (1934) *Landw. Vers. Sta.* **118** : 233-262.

(13) Cholodny, N. (1930) *Arch. Mikrobiol* **1** : 620-652.

(14) Conn, H. J. (1918) *N. Y. (Geneva) Agri. Exp. Sta. Tech. Bul.* **64.**

(15) ——— (1928) *N. Y. (Genera) Agric. Exp. Sta. Tech. Bul.* **138.**

(16) ——— (1932) *N. Y. (Geneva) Agric. Exp. Sta. Tech. Bul.* **204.**

(17) ———and Darrow, M. A. (1930) *N. Y. (Geneva) Agric. Exp. Sta. Tech. Bul.* **172.**

(18) Curie, I. H. (1931) *Soil Sci.* **32** : 9-25.

(19) Demeter, K J. & Mossel, H. (1933) *Centbl. Bakt.* (II) **88** : 384-392.

(20) Demidenko, T. T. (1928) *J. Landw. Wiss.* **5** : 528 540.

(21) Demolon, A. & Dunez, A. (1933) *Compt. Rend. Acad. Sci.* (Paris) **197** : 1344-1346.

(22) Dubos, R J. (1928) *Ecology* **9** : 12-27.

(23) Eaton, E. D. & King, C. J. (1934) *J. Agric. Res.* **49** : 1109-1113.

(24) Ezekiel, W. N. & Taubenhaus, J. J. (1934) *J. Agric. Res.* **49** : 843-858.

(25) Fraps, G. S. & Sterges, A.J. (1935) *Soil Sci.* **39** : 85 94.

(26) Gainey, P. L. (1928) *Proc. First Internat. Congr. Soil Sci.* **3** : 107-117.

(27) Graf, G. (1930) *Centbl. Bakt.* (II) **82** : 44-69.

(28) Gray, P. H. H. & McMaster, N. B. (1933) *Canad. J. Res.* **8** : 375-389.

(29) Haas, A. R. C. (1932) *Hilgardia* **6** : 483-559.

(30) Henckel, P. (1933) *Microbiol.* **2** : 28.

(31) Hof, T. (1935) *Rec. Trav. Bot. Neerland.* **32** : 92-173.

(32) Hurd-Karrer, A. M. (1934) *J. Agric. Res.* **49** : 343-357.

(33) Jenny, H. (1930) *Missouri. Agric. Exp. Sta. Res. Bul.* **152**

(34) Jensen, H. L. (1934) *Proc. Linn. Soc N. S. Wales* **59** : 101-117.

(35) ——— ——— (1934) *Ibid.* **59** : 200-211.

(36) Joffe, J. S. & Conn, H. J. (1923) *N. Y. (Geneva) Agric. Exp. Sta. Tech Bul-* **97.**

(37) Johnson, D. E. (1931) *Phytopath.* **21** : 843-863.

(38) Jordan, H. V., Dawson, P. K., Skinner, J. J. & Hunter, J. H. (1934) *U. S. Dep Agric. Tech. Bul.* **426.**

(39) Karpinskaya, N. S. (1930) *Trans. Ak-kavak Exp. Irrig. Stat. U. S. S. R.* **7** : 111-121.

(40) King, C. J. & Eaton, E. D. (1934) *J. Agric. Res.* **49** : 793-798.

(41) King, C. J., Hope, C. & Eaton, E. D. (1934) *Ibid* **49** : 1093 1107.

(42) Knight, H. G. (1934) *Rept. of the Chief of the Bureau of Chemistry and Soils. U S. Dept. Agric.*

(43) Koffman, M. (1934) *Arch. Mikrobiol.* **5** : 246-302.

(44) Kostytschew, S. P. (1930) *Bul. Inst. Agric. Microbiol. U. S. S. R.* **4** : 29-40.

(45) Krassilnikov, N A (1934) *Microbiology.* **3** : 343-359.

(46) Kubiena, W. (1932) *Biol. Generalis* **8** : 514-546.

(47) ——— ——— (1932) *Arch. Microbiol.* **3** : 507-542.

(48 ——— ——— (1932) *Soil Res.* **3** : 91-102.

(49) ——— ———& Renn, C. E (1935) *Centbl. Bakt.* (II) **91** : 267-292.

(50 Lipman, C. B. (1934) *Science* **79** : 230-231.

(51) ——— ——— (1935) *J. Bact.* **29** : 3.

(52) Lochhead, A G. & Thexton, R. H. (1935) *J. Bact.* **29** : 77.

(53) Loehwing, W. F. (1934) *Plant Physiol.* **9** : 567-583.

(54) Mckinley, A. D. (1931) *Soil Sci.* **32** : 469-480.

(55) McLennan, E. (1928) *Ann. Appl. Biol.* **15** : 85-109.

(56) McNamara, H. C., Wester, R. E. & Gunn, K. C. (1934) *J. Agric. Res.* **49** : 531-538.

(57) Mehlich, A. Fred, E. B. & Truog, E. (1934) *Soil Sci.* **38** : 445-461.

(58) ——— (1933) *Soil Sci.* **35** : 259-277.

(59) Melin, E. (1933) *Arch. Microbiol.* **4** : 509-513.

(60) ——— & Nannfeldt, J. A. (1934) *Sartryck ur Svenska Skogsvardsfor. Tidskr.* III-IV. 397-616.

(61) Mishustin, E. C. (1933) *Microbiology.* **2** : 174.

(62) Mowry, H. & Camp., A. F. (1934) *Fla. Agric. Exp. Sta. Bul.* **273.**

(63) Neal, D.C., Wester, R. E. & Gunn, K. C. (1933) *J. Agric. Res.* **47** : 107-117.

(64) ——— (1934) *J. Agric. Res.* **49** : 539-548.

(65) Niklas, H., Poschenrieder, H. and Trischler, J. (1930) *Ztschr. Pflanzenernahr-Dungung u. Bodenk.* (A) **18** : 129-157.

(66) Perry, G. S. (1933) *Service Letter Penn. Dep. Forests and Waters. Ser.* **4** : 2.

(67) Poschenrieder, H. (1930) *Centbl. Bakt.* (II) **80** : 369-378.

(68) Reed, H. S. & Dufrenoy, J. (1935) *Hilgardia* **9** : 113-141.

(69) Reid, R. D. (1935) *J. Bact.* **29** : 215-231.

(70) Reuszer, H. W. (1931) *J. Amer. Soc. Agron.* **23** : 417-428.

(71) Rhines, C. (1935) *J. Bact.* **29** : 299-311.

(72) Rossi, G. & Gesue, G. (1930) *Ann. Technica Agr.* **3** : 196-248.

(73) Sanford, G. B. (1926) *Phytopath.* **16** : 525-547.

(74) ——— & Broadfoot, W.C. (1931) *Sci. Agri.* **11** : 512-528.

(75) Schalk, A. F., Roderick, L. M., Foust, H. L. & Harsfield, G. S. (1935) *N. D. Agric. Exp. Sta. Tech. Bul.* **279.**

(76) Sheloumova, A & Faerman, V. (1928) *State Inst. Exp. Agron. U. S. S. R. Bul. Bur. Agri. Microbiol.* **3** : 3-27.

(77) ——— & Protodiakonov, O. (1930) *Bull. Inst. Agr. Microbiol. U. S. S. R.* **4** : 41-69.

(78) ——— & ——— (1933) *Bul. State. Inst. Agri. Microbiol. U. S. S. R.* **5** : 118-130.

(79) ——— , ——— & Faerman, V. (1927) *Stat. Inst. Exp. Agron. U. S. S. R. Bul. Bur. Agr. Microbiol* **2** : 3-28.

(80) ——— & Zaitzeva, E. & Faerman, Nilov, V. (1933) *Bul. Stat. Inst. Agr. Microbiol U.S S. R.* **5** : 131-141.

(81) Starkey, R. L. (1929-1932) *Soil Sci.* **27** : 319-334 ; 355-378 ; 433-444.
Soil Sci. **32** : 367-393 ; 395-404.
Proc. Second Internat. Congr. Soil. Sci. Comn. **3** : 248-259.

(82) Tandon, S.P. & Dhar, N.R. (1934) *Soil Sci.* **38** : 183-189.

(83) Thom, C. & Humfeld, H. (1932) *Soil Sci.* **34** : 29-36.

(84) Tims, E. C. (1932) *Phytopath.* **22** : 27.

(85) Uspensky, E E. (1932) *Soil Microbiology in the U. S. S. R.* (1917-1932

(86) Waksman, S. A. (1931) *Arch. Microbiol.* **2** : 136-154.

(87)	Waksman, S. A.	(1933) *Trans. 2nd. Comn. & Alkali Subcomm. Internat. Soc. Soil Sci.* A : 119-132.
(88)	Waksman & Diehm, R.A.	(1931) *Soil Sci.* **32** : 73-95 ; 97-117 ; 119-139.
(89)	——— & Iyer, K.R.N.	(1931-33) *Soil Sci.* **34** : 43-69 ; 71-79. **36** : 57-67 ; 69-82.
(90)	——— & Purvis, E. R.	(1932) *Soil Sci.* **34** : 323-336.
(91)	——— & Reuszer, H. W.	(1932) *Soil Sci.* **33** : 135-151.
(92)	Walker, R. H. & Brown, P. E.	(1935) *J. Bact.* **29** : 77.
(93)	Weindling, R.	(1932) *Phytopath.* **22** : 837-845.
(94)	Wilson, J. K.	(1926) *J. Amer. Soc. Agron.* **18** : 911-919.
(95)	Winogradsky, S.	(1924) *Compt. Rend. Acad. Sci. (Paris)* **179** : 367-371.
(96)	———	(1925) *Ann. Inst. Pasteur* **39** : 299-354.
(97)	———	(1926) *Ann. Inst. Pasteur* **40** : 455-520.
(98)	———	(1929) *Ann. Inst. Pasteur* **43** : 349-633.
(99)	———	(1933) *Ann. Inst. Pasteur* **50** : 350-432.
(100)	——— & Ziemieck, J.	(1928) *Ann. Inst. Pasteur* **42** : 36-62.
(101)	Ziemieck, J.	(1935) *Centbl. Bakt.* (II) **91** : 379-394.

Grain found in vases in ancient tombs is practically carbonized from age and will not sprout in spite of numerous stories to the contrary. Science News Letter.

CULTIVATION OF RICE IN INDIA.

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Introduction.

Rice is by far the leading crop of India. It is grown in India from very early times as mention has been made of it in the vedic literature. In point of acreage as well as total value of production, the rice crop ranks foremost in Indian Agriculture ; and, since about two-fifths of the total crop are put on the market, its importance as a cash crop is obvious. In recent years rice has become the third most important food grain in international commerce, and ranks next to wheat and maize. Generally speaking, the rice growing areas are the most thickly populated parts of the world, and as such it feeds the maximum mouths as a single crop. It alone occupies 24 per cent of the total area sown in India which is the highest acreage for a single crop in this country.

Distribution.

It thrives best in regions of high temperature and abundant moisture, and the crop is generally grown in fields susceptible of being flooded at certain stages of its growth. Hence, the greatest areas under rice are located in river deltas, in low-lying coastal districts, and in tracts subject to inundation during the summer rains. Where the water supply is abundant, and the summers sufficiently warm, rice may also be grown in hill tracts at high elevations, as for example in Kashmir. Rice culture also exists in Kangra Valley of the Punjab, and many of the lower slopes of the Himalayas.

Rice is of unique importance in Bengal, Madras, Bihar, Orissa, the Central Provinces, and Assam. Rice is also a very large, and valuable crop in the United Provinces, and only ranks second to wheat. In Sind both rice and wheat are of equal importance, while in Travancore and Cochin, rice is the most important local crop. As much as two million acres are normally sown to rice in Bombay Presidency. According to the reports of the Department of Commercial Intelligence and statistics 76·26 million acres were under rice on the average for a period of 10 years excluding an area of about 6·07 million acres important for the cultivation of rice for which no reports are available.

World Position

The total world output of rice amounted to 95·9 million tons in 1937, of which India's share was 30·9 million tons, representing about 31 per cent of the world's crop. During the same period China's production was 31·5 million tons. India and China account for practically two-thirds of the entire world production of rice. Other countries occupying some position in the world production of rice are Burma, Siam, Japan, Korea, and to a less extent Indo-China, and Phillipines The chief importers of rice are the densely populated Asiatic countries, growing insufficient quantities of this food grain to feed their inhabitants. Among the importers of rice are the countries India, China, Japan, Ceylon, and British Malaya. In Europe, France is the chief importing country, her supplies being mostly obtained from Indo-China.

The three principal exporters of rice are Burma, Siam and Indo-China. The average annual volume of international trade in rice had expanded to about 9 million tons during 1936-'38. Burma's average annual exports amount to some

8 million tons, equivalent to about 30 per cent of the total world trade, of which roughly half normally goes to India.

Italy, Spain, and the United States have captured a valuable position in the international rice trade in Europe and America. A considerable position of rice grown in the above-mentioned countries, consists of large, hard-structured translucent kernels capable of taking high degree of polish.

Seasonal Types.

Of the seven thousands known botanical varieties of rice, about four thousand have been identified in India. It is not surprising, therefore, to find considerable physical variations in the different types cultivated in this country. The easiest way to classify rice will be according to the season in which they are harvested. According to this, all the varieties of rice fall broadly into three classes—Autumn, Winter and Summer crop, and are generally known as aus, aman, boro or dalua respectively.

Winter rice is by far the most important crop, particularly in Bengal, Bihar, Assam and Orissa. The sowing time varies according to locality, but is normally between June and August, while harvesting usually commences about November, and is over by about the end of January. In Bengal, Bihar, and Orissa the winter rices consist mainly of low land rices most of which are sown in beds about June, transplanted in July, and mature in November and December. In Assam, one of the main features of the winter crop is that it is subdivided into two types, one for which the optimum water depth is a few inches, and the other a long-stemmed deep water paddy grown in water, which may be as much as 15 to 20 feet deep.

The autumn crop is sown in May and June, occasionally even as late as July, and is harvested mainly in September. The autumn crop comprises the highland types, and is grown with rain only. These usually have a growing period of 90 to 115 days regardless of the time of sowing. These rices are seldom transplanted. In the United Provinces the autumn rice occupies greater importance as more lands are devoted to it.

The summer crop is put in the ground from about the end of January to early March and is harvested during May and June. It is known as marsh rice, and is commonly grown on the margins of lakes or ponds. It occupies a small percentage of the total area under rice. The seeds are sown in nurseries first and transplanted a month later. The rice of this crop is usually considered to be of poor quality.

Besides these three general types Sail or Sali, and Asra are the two other types grown in Assam. Sail or Sali is sown in nursery in June and July, transplanted a month later, and harvested from November to December. Asra otherwise known as the deep water paddy is usually sown in April and May, and reaped in November and December.

Soil, and Climatic Requirements.

Though rice is grown in a wide variety of soil types, heavy clayey soil rich in organic matter is found favourable for the cultivation of rice. Rice crop normally needs 50 lbs. of nitrogen per acre. As has been already mentioned humid climate with high temperature during the growing period is found to be most suitable for rice plants. It is, for this reason, a crop of the tropical and sub-tropical regions. It can be grown in regions having a rainfall of 50" without any irrigation, while good yields have been recorded in Coorg having a rainfall of 130 inches per annum. Where the rainfall is insufficient but the other

conditions are favourable, good crop of rice can be raised with artificial supply of water. The average irrigated area under this cereal covered 19·7 million acres between 1927-37. About 70 per cent of the total irrigated area under rice in the provinces is located in Madras, Bihar, Bengal and Sind.

Cultural Methods.

Cultural methods vary a great deal depending upon types of soil, local practices, seasonal rainfall, type of rice, availability of labour, etc. Generally speaking, broadcasting and transplanting are the two common methods of raising rice plants. Broadcasting is generally done when the rice is a short duration one, and in the case of long duration ones when labour is not available for transplanting and preparation of the seed bed which calls for greater doses of labour within a limitted period of time.

Broadcasting.—For broadcasting, generally summer ploughing is done. One or two ploughings are done after the rains come. Manures like farm yard manure, compost, and oil cakes are applied to the land at this time. The land is levelled. Seeds are sown either dry and covered by light ploughing which germinate after a shower, or water is made to stand, and seeds are sown which settle down after a while. When the seeds settle down the water is drained off and the seedlings come out within a short time. Sometimes paddy is moistened in water, and allowed to sprout. The sprouted seeds are then broadcast. For broadcasting 20—40 seers of paddy are used. Early crops do not tiller much, so they need a higher seed-rate.

When the plants are a few inches high, water is allowed to stand in the fields. This helps in controlling the weeds. More often when the plants are 6″—8″ high, about a month after sowing, a cross ploughing is done in broadcast fields. This helps to kill the weeds, thin the plants, and supply stimulation for vigorous growth to the plants. In the broadcasted fields it becomes necessary for weeding if the weeds become numerous. No other care is needed after this in a normal crop of rice except harvesting. Some people advocate alternate draining and collecting of water in rice fields for better growth. After the dough stage when the grains have set, the water is generally drained off completely to enable uniform maturity.

Tarnsplanting.—Generally the seeds are first sown in well manured specially prepared seedbeds. The preparation of the seedbed is similar to that of broadcasting. The ratio of seedbed area to the transplanted field may vary between 1 : 8—20 ; a more common ratio is 1 : 10. The seed rate for transplanting rice is half that for broadcasting. The sowing may be done when the nursery is either moist or wet, and the seeds used may be dry or spouted. Some believe that plants from moist nurseries grow better. Plants are removed from the nurseries after 3—4 weeks. Generally, those varieties of the crop which take a longer time to mature, are allowed to stand for a longer time in the nursery.

The fields in which the rice is to be eventually grown is ploughed once in the meanwhile, and water is allowed to stand for some days. The land is puddled to a thin consistency and manured. It is levelled to be ready for transplanting.

The plants are removed from the nursery by uprooting them in small bundles which are tied by means of the leaves. Prior to uprooting, water is allowed to stand in the nursery which softens the soil and thus facilitates the process of uprooting. These are transplanted by means of hand labour in the fields. It is best to transplant in cloudy days ; and, in order to check transpiration to some extent, the top portions of leaves are sometimes removed. It also helps to remove some of the insects that attack the tips of leaves in the nursery. Sometimes ripening of the seedlings is done. This consists in piling up the bundle together in such a manner that the leaves of plants face inwards. The heat produced in

this way is sufficient to kill most of the insects that attack the seedlings. It has been observed that no harm whatsoever accrues in delaying the planting up to 3—5 days after the seedlings are pulled out. There is some reason to believe that the root-pruning which takes place in transplanting is responsibls for good tillering and vigorous growth.

The plants strike roots within 3—5 days after transplanting. When the plants establish themselves in the soil, water is allowed to stand in the fields. If the seedbed for transplanting is properly made, and water is subsequently allowed to stand, no weeding will be necessary. The crop in the normal course will get ready for harvest. Draining the fields from time to time, and complete withdrawal of water well ahead of ripening stage are found helpful.

If the growth of rice plants is found restricted due to lack of manure during the growing period, ammonium sulphate or potassium nitrate may be applied in small doses. The rice plant responds readily to the application of these manures. It is a wise policy to apply these fertilizers in small doses as floods may carry away the water in the rice fields.

Harvesting.—This is usually done by cutting the plants either low from the ground, or a few internodes below the ear. When the varieties are susceptible to shattering, the plants are harvested before the grains are quite mature, and allowed to dry. The threshing is done either by beating with a flail, or more often by treading by bullocks. The yield per acre varies widely depending on various factors. The average yield is about 800 lbs., while 3,500 lbs. have also been recorded per acre.

The main factors affecting yield are summarised below :

Water has probably the most important influence on yield. In the regions where rice is grown mainly as a rainfed crop, the timely onset of the monsoon as well as the distribution of rainfall throughout the growing season equally affect the yield. Rice is a crop, the water requirement of which is very great. As the water available affects the growth of crop, the lands having irrigation facilities show a greater degree of stability in the yield per acre, and in such lands the yield is always more than those having no irrigation facilities.

In heavy soils rice does better than on light soils. Heavy soils are highly retentive of moisture, and also capable of being puddled thoroughly, a condition which is favourable for good root development of young seedlings when transplanted.

The season when the crop is grown is also important. Generally, winter rice gives the largest yields, followed by the summer crop, while the autumn rice gives the smallest yield. Again, the yield also depends on the varieties of rice grown. Bold or coarse rices under similar conditions of soil, weather, and cultural treatment generally yield more abundantly than the small, fine, slender varieties. Records show that bold types give roughly from 15 per cent to 60 per cent more yield than fine rices.

The cultural practices followed influence the yield of rice to a large extent. Transplanted rice normally gives a higher yied than when the crop is broadcast. While transplanting, the farmer should be careful about a number of things :

(1) The age of seedlings at the time of transplanting.—It has been found that the best period for transplanting is when the plants are between thirty-five and forty-five days old, depending on the stage of growth.

(2) The number of seedlings planted per hole.—It is best to plant 2—3 seedlings per hole. More than this number lowers the yield as a strong competition ensues between plants, and the tillering capacity is reduced. When the seedlings are vigorous, *i.e.*, seedlings with thick stem, broad leaves, and with dark green colour, one seedling per hole is sufficient to give good yield per acre.

(3) The spacing between plants is equally important, and an ideal condition is provided when 6" are allowed between plants in a row, and one foot from row to row.

Manuring has profound effect on the yield of rice. Where rice is followed after rice, the land is apt to be devoid of plant nutrients. The productivity of the soil should be restored by liberal supply of plant nutrients in the form of various manures. Green manuring with sannhemp, dhanchia, (sesbania aculeata or green leaves have been found practical. Similarly, farm yard manure, composts, or oil cakes may be profitably applied. A more practical way of supplying plant nutrients is the application of farm yard manure, compost, or oil cake, and fertilizers like ammonium sulphate or potassium nitrate in parts.

General Discussions

Rice culture is perhaps one of the most laborious of all agricultural occupation. In order that the grower's returns may be enhanced, he should be thoroughly aware of the main factors determining quality on which price differences are based. In the case of paddy, price differences due to quality are based on (*a*) grain size, (*b*) milling quality, (*c*) age, and (*d*) Physical characteristics.

(*a*) Grain size : Fine paddies are normally dearest, and the bold the cheapest, with the medium varieties falling between the two extremes.

(*b*) Milling quality. It is judged by rubbing a few grains of paddy between the palms of hands, or by means of two small wooden boards. Differences arising from this factor are more pronounced in tracts notable for raw rice production.

(*c*) Age : Premiums for paddy harvested 12 to 15 months previously are paid in respect of a number of varieties in some provinces.

(*d*) Physical characteristics : The presence of foreign matter, defective grains, admixture of other varieties, and moisture content also determine the value of paddy.

The main quality factors on which price differences of rice are based are (*a*) conformation, (*b*) raw or parboiled (*c*) machine-milled or hand-pounded, (*d*) variations in grade or quality (*e*) age (*f*) colour and aroma.

(*a*) Conformation : Generally fine rices are relatively costly and coarse varities cheap, and medium ones of intermediate values. The fine types are dearer by 55 to 71 per cent than bold rices.

(*b*) Raw or parboiled : If the prices of raw and parboiled rice prepared from the same variety of paddy are compared, it is found, that parboiled rices are generally cheaper than their raw prototypes. It has been observed that parboiled rices are cheaper than raw rices by an average of from 8 to 10 annas per maund in respect of fine and medium rices, and anything from 1 to 6 annas for the bold types.

(*c*) Machine-milled or hand pounded—Fine and medium hand-pounded rices are generally dearer than machine-milled, with some exceptions of medium varieties. The premium on hand-pounded rice does not always apply to bold quality.

(*d*) Variations in grade or quality—so far as price relates to differences due to variations in the grade or quality due to impurity, broken grains, etc., it should be noted that with the exception of a number of grade specifications laid down comparatively recently under the provisions of Grading and Marketing Act., 1937, in respect of certain specified varieties of rices, no generally accepted standards of quality are recognised in respect of Indian rices.

(*e*) Age : Old stored rice or rice produced from old paddy generally sells dearer than the newly harvested produce. This is especially so in the case of finer verieties which are held in store with the express object of taking advantage of the premiums.

(*f*) Colour and aroma : In many instances rices tinted by external application of colouring agents are sold at a small premium over their untreated counterparts derived from the same variety of paddy. Colour is, however, a quality factor mainly local in character, and of minor importance. Aroma, on the other hand, fetches a higher premium specially in fine types of rice.

Conclusion and Recommendations.

In conclusion the following lines are quoted from the "Report on the marketing of Rice in India and Burma" :

"To bring about improvement in the existing system, many aspects have to be tackled. If the Agriculture and co-operative departments, the marketing staff, the Government, and the municipal organisations in various provinces and States, and, above all, the trade and producers co-ordinate their efforts, a substantial measure of success can be expected."

In the end it is desirable to refer to the various ways of improving the cultivation of rice and the rice trade so that the cultivator may reap the maximum benefit with minimum labour.

In the first place transplanting of rice should be done as much as possible. It is easier to provide proper spacing in transplanting than in broadcasting. On the average, it has been found that the transplanted rice yields more.

Facilities for watering should be provided. As the water requirement for this crop is very great, irrigation is indispensable for higher yield. Without proper facilities for irrigation the cultivation of rice is simply hazardous.

Research in the direction of harvesting technique, and cheap mechanical threshers will reduce the cost of production. Much has to be done in the marketing side. Inducement should be done among the growers to co-operate for storing. Generally, a depression in price occurs after harvest. As paddy keeps better than rice facilities should be provided to store paddy in ferro-concrete underground bins. The optimum period of stage of paddy compatible with good milling results should be found out. From a marketing point of view, it is desirable that there should be a reduction rather than an increase in the number of varieties and greater uniformity in the type of rice in each tract. Standardised classification and grading of rice will assist the machinery of distribution at all stages. This will help in the greater uniformity of production types, and reduction of the heterogenous number of varieties and trade descriptions. Standardisation of weights and measures, and the reduction of railway freights, and municipal tolls will facilitate the rice trade.

The chief factors responsible for the rice grower's low share margin as brought out by the Agricultural marketing in India are the use of seed having an admixture of inferior types, inefficient handling at the harvesting stage, wastage in hulling, disproportionate margins earned by intermediaries in the process of assembling and distribution, malpractices and excessive deductions in the markets, non-existence of recognised standards of quality, lack of uniformity in weights and measures, and exorbitant interest charges paid on loans incurred for seed and financing the cultivation of the crop. Even the town-dweller is responsible for reducing the cultivator's price through municipal octroi, etc.

Acknowledgment.

Considerable help has been derived by the writer from the Marketing Report on Rice published by the Imperial Council of Agricultural Research.

A list of wild plants found in the Upper Gangetic Plain and the adjacent Siwalik and Sub-Himalayan Tracts, used as vegetables.

Compiled by Mr. M. A. A. Ansari, M. Sc., Economic Botanist (Cotton, Paddy and Rabi Cereals), U. P.

Botanical Name.	Vernacular Name.	Family.	Locality.	Remarks.
1. Dillenia Indica ..	Chaltr ..	Dilleniaceae ..	Tropical forests at the base of the Himalayas; possibly wild in N. Oudh.	The acid calyx surrounding the ripe carpels is eaten raw or cooked in curries and is also used for making a jelly.
2. Dillenia Pentagyna ..	Aggai ..	Do. ..	Sal forests of Rohilkhand, Oudh and Gorakhpur.	The pleasantly acid flower buds and young fruits are eaten raw or cooked. The ripe fruit is also eaten.
3. Nymphsea lotus ..	Ohhota Kanwal Indian Lotus	Nymphaeaceae	Common throughout the area.*	The tuberous underground stems are eaten.
4. Nymphsea Stellata ..	Banbher ..	Do. ..	Abundant within the area.* ..	The rhizomes and the seeds are often eaten specially in times of famine.
5. Capparis aphylla ..	Karil ..	Capparideae ..	Abundant in the drier portion of the area* associated with salvadors. Acacia leucophloea.	The flower buds and the young fruits are cooked and eaten as a pot-herb.
6. Flacourtia ramontchivar sapida	Bilangrakandai Kango	Bixine ..	Gangetic plain	The fruits are eaten raw or cooked.
7. (*a*) Polygala chinensis ..	..	Polygaleae ..	Dehra Dun, Moradabad, Agra, Bundelkhand.	The plant is eaten during femine times in western India.
(*b*) Portulaca quadrifida	..	Portulaceae ..	A common weed throughout the area*. In dry places it becomes very stunted with the stipulary hairs long and shaggy.	It is much used as a pot-herb by poorer classes.
8. (*a*) Malva verticillata ..	..	Malvaceae ..	Kheri District Oudh, Merwara ..	The leaves and tender shoots are sometimes cooked and eaten as spinach.

*Area means the Upper Gangetic plain and the adjacent Siwalik and Sub-Himalayan Tracts.

A List of wild plants (*contd.*)

Botanical Name.	Vernacular Name.	Family.	Locality.	Remarks.
8. (*b*) Sida veronicaefolia ..	..	Malvaceae ..	Common throughout the area; hotter parts of India.	The plant is used as a pot-herb.
(*c*) Bombax malabaricum	Semal, silk cotton tree	Do. ..	Common in forests especially along the base of the Himalaya, outer Himalaya upto 3,000'.	The calyx of the flower buds is eaten as a vegetable.
9. Malva parviflora ..	..	Do. ..	A common weed in rich soil flowering during the cold season.	Frequently eaten as a pot-herb in times of scarcity.
10. Tribulus terrestris ..	..	Zygophylaceae	Plentiful within the area* specially in sandy and rocky places.	The young parts are eaten as pot-herb; and the flour prepared by grinding the prickly fruits is largely consumed by many people during time of famine.
11. (*a*) Cxalis corniculata ..	Amrul, chalmori Indian sorrel	Geraniaceae ..	Common within the area specially in cultivated grounds.	The leaves are used as pot-herb by the poorer classes.
(*b*) Garuga pinnata ..	Kharpat, ghogar ..	Burseraceae ..	Dehra Dun and Saharanpur forests, Rohilkhand, Oudh and Gorakhpur, Himalaya upto 3000'.	The acid drupe is eaten raw or cooked.
(*c*) Zizyphus cenoplia ..	Makai, Makoh bamolan	Rhamneae ..	Abundant within the area*; hotter parts of India.	The fruit is eaten
12. Cardiospermum halicacabum.	..	Sapindaceae ..	Common within the area* climbing on hedges and over bushes. Distribution all over hotter parts of India, ascending to 4,000' in W. Himalaya.	The leaves are sometimes cooked and eaten as vegetable.
13. Moringa concanesis ..	Sainjna ..	Moringeae ..	Merwara forests. Distribution Baluchistan, Sindh, Rajputana, Bombay. Flower in November and December.	The unripe fruit and the flower are eaten as a pot-herb.
14. Rothia trifoliata ..	..	Leguminosae	Bundelkhand. Distribution South to Ceylon.	The leaves and pods are boiled and eaten as vegetable by the poorer classes.

15.	Canavalia ensiformis ..	Sem, bara sem, (sword bean)	Do. ..	Cultivated to large extent within the area either on borders of fields or very frequently it is allowed to climb over the roof of natives huts; a form of this plant is found wild in Bundelkhand, but its seeds are bitter.	The pods when young are much eaten by the people of India; and the pods when young are sliced and cooked as a make shift for French Beans.
16.	Sesbania grandiflora ..	Beasna ..	Do. ..	This plant is grown within the area chiefly for this sake of its ornamental appearance. It is cultivated in other parts of India as a support for betel wine.	The young leaves pods and flowers are eaten as a vegetable.
17.	Indigofera pulchella ..	..	Do. ..	Dehra Dun and Siwalik range in Sal forests, forests of N. Oudh and Bundelkhand, Merwara, and Rohilkhand.	The pink flowers are eaten as a vegetable.
18.	Cassia obtusifolia ..	Panwar ..	Do. ..	A very common weed all over the area by the road side and in waste ground flowering during the rains, upto 4,000' in W. Himalayas.	The tender leaves are boiled and used as a pot-herb.
19.	Smithia sensitiva ..	..	Do. ..	Dehra Dun and Siwalik Range outer western Himalayas to Khassia Hills.	The leaves are eaten as a pot-herb.
20.	Cassia auriculata ..	Tarwar, awal (Rajputana)	Do. ..	Etawah, Gorakhpur, Bundelkhand, Ajmer Merwara, from Central India to Ceylon.	The leaves are eaten as a vegetable in times of scarcity.
21.	Bauhinia purpurea Khairwal	..	Do. ..	Forests of Dehra Dun, and Siwalik range, Rohilkhand, N. Oudh and Bundelkhand.	The flower buds are eaten as pot-herb.
22.	Bauhinia Variegata ..	Kachnar ..	Do. ..	Forests of Dehra Dun and the Siwalik range, Rohilkhand, Oudh and Bundelkhand, outer range of Himalaya upto 4,000'.	The flower buds are eaten as vegetable.
23.	Neptunia oleracea ..	Laj-alu ..	Do. ..	In swamps and slow flowing streams, throughout India.	The plant is used as a pot-herb.

*Area means the Upper Gangetic plain and the adjacent Siwalik and Sub-Himalayan Tracts.

A List of wild plants (*contd.*)

Botanical Name.	Vernacular Name	Family.	Locality.	Remarks.
24. Acacia leucophloea ..	Safed Kikar, reru, raung, arinj karir, nimbar, jhind	Leguminosae ..	Abundant in the drier parts of the Doab, also in Rohilkhand, Bundelkhand and Merwara, Rajputana, Central India.	The young pods and seeds and even the powdered bark mixed with flour are eaten in times of scarcity.
25. Bauhinia malabarica ..	Amli, imli, khat papri, khatta jhinjhora	Do. ..	Forests of Dehra Dun and the Siwalik range, Rohilkhand and N. Oudh.	The leaves are very acid and are sometimes eaten.
26. Trichosanthes cucumerina	Jangali Chichinda	Cucurbitaceae	Common within the area* and found on hedges. Distribution throughout India.	The fruit which ripens in the rains is largely eaten as vegetable and the young tops as a pot-herb.
27. Momordica dioica ..	..	Do. ..	Common within the area*; throughout India, ascending to 5,000' on Himalayas.	The young fruit is eaten in curries and tuberous roots are also eaten.
28. Bryonopsis laciniosa ..	Bilanja ..	Do. ..	Common within the area*; throughout India from Himalaya to Ceylon.	The leaves are sometimes boiled and eaten as a vegetable.
29. Trianthema monogyna	..	Ficoideae ..	Common within the area*; throughout India and Ceylon.	The stem and leaves are eaten as vegetable.
30. Trianthema pentandra	..	Do. ..	Rohilkhand, Etawah, Agra and Merwara Dists.	The plant is eaten as a pot-herb in times of scarcity.
31. Mollugo hirta ..	Bilanja ..	Ficoideae ..	Common within the area*; throughout India and Ceylon and in all warm regions.	The tender shoots are eaten as a pot-herb.
32. Mollugo pentaphylla ..	..	Do. ..	Very common within the area*; throughout India and Ceylon ascending to 5,000' on the Himalaya.	The tender shoots are eaten as a pot-herb.
33. Hydrocotyle asiatica ..	Asiatic penny-wort	Umbelliferae ..	Common within the area*; throughout India from the base of Himalaya.	The leaves are eaten in times of scarcity.
34. Apium graveolens ..	Ajmud (wild celery)	Do. ..	Dehra Dun, Banda in wet ground ..	The blanched stems and leaf stalks are eaten by Europeans.

35.	Vernonia cinerea ..	..	Compositae ..	Abundant within the area*, and very variable especially in regard to its foliage.	The leaves are sometimes eaten pot-herb.
36.	Glossocardia linearifolia	..	Do. ..	On sandy ground especially in the districts of Dehli, Agra, Merwara and Bundelkhand.	The plant which has a scent like that of fennel is eaten as a vegetable especially in years of scarcity.
37.	Sonchus oleraceus ..	..	Do. ..	Abundant within the area*, especially on cultivated ground; throughout India, upto 8,000" on the Himalaya.	The leaves are sometimes used as a vegetable.
38.	Lobelia trigona ..	..	Companulaceae	Dehra Dun, Guna, flowers after the rain.	It is said to be eaten as pot-herb in Chhota-Nagpur.
39.	(*a*) Bassia latifolia ..	Mahua, Mohwa, The Mahua tree.	Sapotaceae ..	Dehra Dun and on the Saharanpur Siwalik but more abundant eastwards in the sub montane forests tracts of Rohilkhand and N. Oudh also in Budelkhand.	The sweet succulent corollas are eaten either raw or cooked. The fruit is also eaten.
	(*b*) Salvadora persica ..	Kharjal ..	Salvadoraceae	In drier and southern outskirts of the area* in the neighbourhood of Delhi, Agra, Muttra and on the banks of the Ganges as far as Patna especially on saline soils.	The pungent leaves are eaten as a salad.
40.	(*a*) P. Viminea ..	Mahur ghas, chapkia khip.	Asclepiadaceae	Common in the Siwalik range in stream beds and on the banks of the river, in Dehra Dun, Bijnor forests, Gonda. district of N. Oudh, westwards to Delhi and Merwara.	The flower buds are eaten as a vegetable.
	(*b*) Ceropegia bulbosa ..	..	Do. ..	In the Doab of the upper Gangetic plain near Allahabad, also in Bundelkhand growing on waste land and amongst bushes.	Roxburgh says every part of this plant is eaten by the people either raw or stewed in their curries, the fresh roots tasting like a raw turnip and the stems and the leaves like purslane.
41.	Limnanthenum cristatum	Ghuli ..	Gentianceae ..	Very common within the area* in ponds and ditches, throughout India.	The stem leaves and fruits are often eaten in certain parts of India more particularly in times of famine.

* Area means the Upper Gangetic plain and the adjacent Sewalik and Sub-Himalayan Tracts.

A List of wild plants.—*(contd.)*

Botanical Name.	Vernacular Name.	Family.	Locality.	Remarks.
42. Merremia emarginata ..	..	Convolvulaceae	Bundelkhand.	The plant is sometimes eaten as a pot-herb.
43. Ipomaea hispida ..	..	Do.	Dehra Dun, Rohilkhand, Bundelkhand; throughout India: upto 4,000' on the Himalaya	The leaves and stem are often eaten as vegetable.
44. Ipomaea reptans ..	Kalmi ..	Do. ..	In most parts of the area*, very common in ponds, ditches and moist ground; throughout India and Ceylon.	The young shoots and roots are eaten as vegetable.
45. Ipomaea sepiaria ..	..	Do. ..	Common within the area* and found in hedges; throughout India and Ceylon.	It is sometimes eaten as a pot-herb.
46. (*a*) Rivea hypocrateriformis.	Phang, the Midnapore or clove scented creeper.	Do. ..	Often met with within the area* especially in the forests tracts of Merwara and Bundelkhand.	The leaves and young shoots are eaten as a vegetable.
(*b*) Solanum nigrum ..	Makoi, (Black Night shade).	Solanaceae ..	A common weed especially in cultivated ground. Flowers during the cold season in the plains.	The leaves and young shoots are eaten as a spinach.
47. Hygrophila angustifolia	..	Acanthaceae ..	Common in wet grounds in most parts of the area*.	The leaves are sometimes eaten by the people as a pot-herb.
48. Clerodendron serratum..	Baranji, ban-bakri	Verbenaceae ..	Common in the Sub-Himalayan tracts from Dehra Dun eastwards.	The young leaves and the flowers are eaten as a vegetable.
49. Boerhaavia diffusa ..	..	Nyctaginaceae	An abundant weed within the area* of this flora and variable in habit and pubescence according to soil and situation.	The leaves are eaten as a pot-herb.
50. Digera arvensis ..	..	Amaranthceae	Common and widely distributed over the area* of this flora, flowering usually after the rains are over.	The leaves are often used as a pot-herb.

51. Amaranthus spinosus ..	Prickly Amaranth	Do. ..	Found abundantly in all parts of the area* and often troublesome as a weed in the fields and gardens.	The leaves are often eaten as a spinach.
52 Amaranthus polygamus	..	Do. ..	A common weed in gardens and cultivated land throughout India and in Ceylon.	The plant is largely used as a pot-herb and is considered to be very wholesome.
53. Chenopodium album ..	Bathu, Bathusag, Chel ; white goose foot.	Chenopodiaceae	A very common weed throughout the area* especially in cultivated ground and in waste places, very variable.	The plant is very rich in potash, salts and the leaves are often eaten raw as a salad or cooked as a pot-herb.
54. Suaeda maritima ..	Lani, Khari lani ..	Do. ..	In the neighbourhood of Delhi, also on the usar tracts in the upper Gangetic plain.	The leaves which are quite wholesome are eaten by poorer classes in times of scarcity.
55. (*a*) Basella rubra ..	Poi, lal-bachlu (Indian spinach).	Do. ..	Wild and cultivated within the area*; throughout hotter portion of India and Ceylon.	It is usually raised from cuttings and planted so as to climb over the roofs of native houses and trellises where it affords both shade and food.
(*b*) Chenopodium murale	..	Do. ..	Upper Gangetic plains, on the Himalaya in Kumaun and Nepal.	The plant is used as a pot-herb in the Punjab.
56. Polygonum glabrum ..	..	Polygonaceae..	Abundant in all parts of the area* in swamps and by streams. Throughout the greater part of India and in wet places, ascending to 6,000' on the Himalaya.	The pungent leaves and young shoots are cooked by the people in certain parts of India and eaten as an adjunct to other vegetable.
57. Rumex Hastatus ..	Chulmora ..	Do. ..	Found occasionally in Dehra Dun at the base of the Himalaya. It is a common plant on the W. Himalaya ascending to 8,000' and is found usually on exposed rocks and dry stony hillsides.	The leaves are very acid and may be eaten as salad.
58. Euphorbia granulata ..	..	Euphorbiaceae	Jumna ravines near Agra, Chambal ravines near Etawah, Rohilkhand, Bundelkhand and Malwa.	The leaves are said to be often used as a pot-herb.

* Area means the Upper Gangetic plain and Adjacent Siwalik and Sub-Himalayan Tracts.

A List of wild plants.—(*contd.*)

Botanical Name.	Vernacular Name.	Family.	Locality.	Remarks.
59. Antidesma Chaesembilla	..	Euphorbiaceae	Common in the Sub-Himalayan forests of Rohilkhand, North Oudh, and Gorakhpur.	The leaves are eaten.
60. Antidesma diandrum ..	Kali, Khatai Dhakki, amli.	Do. ..	Common in Sal forests of Dehra Dun and Saharanpur and eastwards along the Sub-Himalayan tracts of Rohilkhand, N. Oudh and Gorakhpur.	The leaves and the small reddish fruit have a pleasantly acid taste and are much eaten raw.
61. Girardinia heterophylla	Bichua, Chichru, Kushki.	Uriticaceae ..	Abundant in Dehra Dun and eastward along the Sub-Himalayan tract.	The leaves are often used as a vegetable by the village people of Western Himalaya.
62. Pouzolzia viminea ..	..	Do. ..	Dehra Dun is moist shaddy ravines, Himalaya from the Sutlaj eastwards to Sikkim ascending 7,000'.	The leaves are eaten in Sikkim by the *Lenchas* as a cooked vegetable.
63. Asparagus adscendens ..	Satawa, Satmuli ..	Liliaceae ..	Dehra Dun in Sal forests, Rohilkhand N. Oudh in the district of Kheri and Gonda, W. Himalaya from Kumaun eastwards to Hazara.	The young shoots are eaten as a vegetable.
64. Ficus Roxburghii ..	Trimmal, timla ..	Urticaceae ..	Dehra Dun and Siwalik ranges and eastwards along the Sub-Himalayan tract, Himalayan ranges but rarer towards the west.	The fruit is much eaten either raw or cooked.
65. Ficus glomerata ..	Gular, Umri ..	Uritcaceae ..	A common tree within the area* and also largely planted in villages; throughout greater part of India.	..
66. Sagittaria Sagittifolia ..	..	Alismaceae ..	Agra, Moradabad, N. Oudh Pilibhit and Gorakhpur, Banda.	The tuberous rhizomes are eaten in China and the plant is often cultivated as a food plant.

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ARTIFICIAL INSEMINATION AND ITS BEARING ON THE LIVESTOCK INDUSTRY OF INDIA.*

G. W. VAIDYA AND P. BHATTACHARYA

Animal Genetics Section, Imperial Veterinary Research Institute, Izatnagar.

Before the War we had about a third of the cattle in the world, though the return in the shape of milk or draught was very meagre in comparison. Germany, used to get as much milk from her 2½ crores of cattle as we did from 18 crores. The exigencies of the War have greatly reduced the number of cattle without any improvement in quality and have thus made the position worse and it is felt that there is an acute shortage of milch cows and working bullocks. It has, therefore, become a question of vital importance that urgent measures be immediately taken to replenish and improve the livestock population. Normal breeding is a time consuming process and the extreme paucity of good breeding bulls and the abundance of small scattered herds in India will delay the programme greatly. If, however, recourse is taken to the scientific methods of breeding, such as artificial insemination, the desired objective may be achieved more quickly. Every effort should, therefore, be made towards the successful adoption of this method in the future animal husbandry system of this country.

Historical

The idea of artificial insemination is not new. The Arabs used it in horse breeding in the middle ages. On sound scentific lines, however, it was first employed in 1779 by Spallanzani, an Italian, in his experiments on dogs. The advantages of employing this method on a large scale were realized by the researches begun at the end of the last century at Cambridge and in Russia. Russia was first to employ artificial insemination in practical husbandry on a large scale and phenominal success has been achieved in the hundreds of insemination centres which are now functioning there. The lead was followed only slowly by other countries. In U.S.A., for example, the first insemination centre was started in 1937 and the number swelled to 99 in 1943. In United Kingdom interest in the pre-war days was mainly limited to research and two centres were opened in 1942. Today there exist about eight insemination centres. The method is also in use in Denmark, Germany, Sweden, Italy, Kenya, Canada, South Africa, Australia, New Zealand and China. In India, sporadic attempts to take up the work have been made since 1939, but comprehensive studies into the problems of artificial insemination with special reference to Indian conditions have been taken up at the Imperial Veterinary Research Institute during the last three years only.

What is artificial insemination

The difference between natural service and artificial insemination is that in the latter the spermatozoa (male seeds) are introduced into the female passage by means of instruments rather than by the male himself. The progeny born as a result of artificial insemination is just as healthy and vigorous and has the same genetic constitution as the offspring produced by the same sire by normal mating.

Advantages

(1) One important advantage of aritificial insemination is that fewer males are required. A few superior, proved sires with characters for high milk yield,

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draft ability, etc., may be used for inseminating hundreds of females anually. This makes a more rigid selection of males possible and the rate of livestock improvement can be accelerated.

(2) By means of artificial insemination certain forms of sterility due to anatomical defects of the female genitalia and the presence of acid secretions in the vagina can be combated. The danger of spread of genital diseases, such as dourine in horses, and contagious abortion in cattle, sheep and goats, can be substantially checked.

(3) Small breeders who of necessity have to make use of a scrub male or a sire of mediocre breeding can, through the use of this method, avail of a sire of outstanding merit.

(4) The transmitting ability of a bull may be ascertained quickly and effectively. Young unproved bulls should be sparingly used until their transmitting ability is determined. By inseminating a large number of cows with semen obtained from a very young bull the progeny test can be completed at an early date.

(5) By artificial insemination progenies from outstanding sires located hundreds of miles away can be obtained.

(6) Valuable sires rendered incapable of giving natural service through old age or injury can be made use of by artificial insemination.

(7) This method can be used where mating is difficult or impossible because of size differences or when crosses between different breeds or species are to be obtained.

(8) Because of regular examination of semen and frequent check on fertility, inferior males and abnormalities of the female genitalia leading to shy breeding are detected earlier than in natural service. These lead to higher fertility records.

Dangers and difficulties

Artificial insemination methods may appear to be simple but they are all highly technical requiring the services of trained and skilled personnel. A worker must have a sound knowledge of the form and functioning of the reproductive organs, of suitable methods of collection and of subsequent treatment of semen. Faulty technique may cause injury to valuable sires while collecting semen, or they may develop a dislike for the method and may later on even refuse to function naturally. Spermatozoa are very sensitive and need special care in handling. There is always a risk of the spread of infection unless all equipment and instruments are scrupulously clean and sterile.

Technique

The method of artificial insemination consists of three operations: (i) the collection of a suitable sample of semen, (ii) its dilution and preservation until used and (iii) the insemination of the female.

Collection : Of the various methods for collecting semen, the one that is most practical and popular is the artificial vagina. The type of artificial vagina used varies slightly from species to species. For the bull it consists of a heavy rubber cylinder about 20 inches in length and 2½ inches in diameter into which a thin rubber tube is placed and doubled over at the ends. The space between the tube and the cylinder is filled, through a hole in the outer cylinder, with warm water at about 45°C. or above, depending upon the climate. The inside of the rubber tube is smeared with pure vaseline. At one end is fixed a glass vessel containing a little medicinal liquid paraffin. A double-walled unsilvered vacuum

cup can be used with advantage, as it prevents the rapid change of temperature of the semen. A pyrex test tube attached to the end of a rubber cone which fits over the end of artificial vagina can also serve the purpose. The temperature of the artificial vagina should be slightly above the body temperature at the time of collection. The pressure should be regulated by putting in or letting out water according to the size of the bull.

For collection of semen, a quiet cow is confined in a service crate. After a little training, the bulls can be trained even to mount cows not on heat. During collection, the artificial vagina is held against the cow's flank with the open end tilted downwards at an angle of about 45°. As soon as the bull mounts the cow, the penis is quickly diverted into the artificial vagina by means of one hand placed on the sheath. When the bull ejaculates, the artificial vagina is tipped up so as to allow semen to run into the glass vessel.

Another method which is of great value when the bulls are incapacitated by old age or bad feet or sore penis and are unable to serve, is to obtain the semen by massaging the ampullae (accessory reproductive organs) with fingers per rectum. The semen obtained by this method is just as good. The method has, however, the disadvantage of requiring special skill and the semen is often contaminated with dirt during collection.

Artificial vaginae of smilar pattern but of smaller dimensions can be used in the case of sheep and goats. For a stallion a bigger model of what is called the 'Cambridge pattern' or 'Missouri type' with a device to collect separately different parts of an ejaculate discharged at intervals, can be used.

Dilution and preservation: Since the fertilizing power of semen depends upon the motility and concentration of spermatozoa, and is adversely affected by the presence of abnormal sperms, the semen sample is examined for these factors under the microscope immediately after collection. The semen is then diluted and preserved in certain fluids which have been found by experience to be suitable for the purpose.

In order to extend the life of male seeds when stored outside the body, it is necessary that they are rendered immobile by gradually lowering the temperature, thus diminishing the respiratory rate of the sperms. Semen should be diluted immediately after collection when insemination is to be made at a later period. The diluted semen may be poured into a small narrow tube and the air completely excluded by filling it with medicinal liquid paraffin. The tube is wrapped with cotton wool and placed in a container tube. It is gradually cooled by placing the container in water at 15°C. and 10°C. for about 30 minutes each and finally stored in a refrigerator or a thermos bottle at about 5°C.

Shipment: For short distances wide-mouthed thermos packed and handled carefully can be used. There are, however, many handicaps in transporting semen to long distances in a thermos as it often breaks during transhipment. Besides it is difficult to maintain a constant low temperature in it even for 24 hours during summer month. A semen shipper has been modified at this Institute to suit Indian conditions, so that a desired range of low temperature can be maintained for three days which is usually the average period for which fertility of bull semen can be preserved outside the body.

Insemination: The equipment used for insemination consists of a small all-glass syringe fitted with a long ebonite nozzle (18 in). A 3/16 in. glass tubing about 20 in. long may replace the ebonite nozzle. This may be attached to the glass syringe with a rubber tubing. A vaginal speculum is also required. The speculum is lubricated and carefully inserted into the vagina and the cervix (mouth of the womb) is located. Semen is drawn into the syringe, the ebonite nozzle or the glass tube is inserted into the cervix to a depth of about 1 in. and the semen is slowly injected. Although impregnation is possible even when the semen is

deposited in the vagina, greater percentage of pregnancies are obtained when it is placed directly into the cervix.

When the speculum and the inseminator are not available, another method is to hold the cervix in position with one hand in the rectum of the cow or buffalo and with the other hand the inseminating tube—a thick-walled glass tube or a catheter—is gently guided into the vagina and into the cervix to a depth of about 1 in. and the semen is blown in.

The latter method has the disadvantage that it requires an expert knowledge of female reproductive organs and long experience of the technique. But it dispenses with the necessity of disinfecting the speculum and makes it easier to deposit the semen deep into the cervix. A separate sterilized tube should be used for every insemination. A separate syringe should also be used for each bull when the former method is employed.

A simple method of insemination is by the use of gelatin capsules. The capsule containing semen is placed in the mouth of the womb. The body heat is sufficient to melt the capsule and to liberate the sperms.

Similar iustruments of varying sizes as in the first method may be used in other animals.

Time factor in the female

Technique, however, is not the all important factor in artificial insemination. To achieve a high degree of success, females should be inseminated at the right time of the season. The union of the male and female reproductive cells (fertilization) takes place in the fallopian tube (a part of the female genital tract farthest from the vagina) and since it requires a few hours for the sperms to travel and reach the egg it is desirable that the insemination is done at about the time of ovulation (shedding of the egg). Accurate information regarding the various reproductive physiological processes in Indian farm animals is wanting. The phenomena vary greatly from breed to breed and sometimes even with individual animals. However, from the knowledge gathered by foreign workers, it can be said that the approximate time of ovulation in relation to heat in mares is two days before the end of the heat until one day after; in the cow 20 to 40 hours after the onset of the heat; in the ewe about one hour before the end of the heat; in does on the second day of heat and in the sow early on the second day of heat. It is generally agreed that in mares, insemination should be done once daily after the first day of heat. When a single insemination is to be made, it should be on the third day of heat and repeated if the mare is on heat three days after artificial insemination. In the cow, the insemination should be done at the end of the heat period and within eight hours after its cessation. In sheep and goats, the suitable time is towards the end of heat period or soon after its termination and in the sow it is during the last half (preferably on the second day) of heat.

Results obtained at Izatnagar

At the Imperial Veterinary Research Institute, Izatnagar, various methods of collection of semen, its preservation and insemination have been tried with success under Indian conditions. The Indian male animals are easily trained to mount females not on heat and to ejaculate into an artificial vagina. The semen thus obtained has been found to be quite good as regards its sperm content, keeping qualities and capacity to impregnate. Various dilutors and preservatives have also been successfully tried. Cows have been impregnated with semen preserved for six daya, buffaloes for three days and sheep for seven days. So far cows, she-buffaloes, ewes and does (goat) have been inseminated successfully using 1/22nd, 1/11th, 1/40th and 1/20th of a single ejaculum. In one experiment, pregnancy

has resulted in a cow by the use of 1/60th of a single ejaculate. The precentage of successful impregnations so far obtained in the experimental animals at Izatnagar is 79 in cows, 80 in goats and 100 in ewes. The overall percentage when the animals belonging to villagers in the vicinity of the Institute are included is 71 in cows, 63 in goats and 75 in ewes. Even the latter percentages show that the method can be successfully employed in Indian farm animals as in those of other countries.

Extension work in villages

Artificial insemination work has been extended to about twenty neighbouring villages within a radius of about 12 miles from Izatnagar. The females on heat are usually brought to the Institute if the villages are very near. A man is also deputed to go round distant villages and to collect the cows or buffaloes on heat in a central village. On receiving the information, semen stored in thermos with the requisite inseminating apparatus is sent to the village and the cattle are inseminated there. Occasionally, the common grazing grounds are visited and the females on heat are inseminated at the spot after taking permission from the owners.

Maintenance of records

In artificial insemination centres, it is essential to keep detailed records. These should include not only the identification number of the male and female, but also all possible details of the condition of the female and the semen with which she is inseminated. The records maintained at the Institute contain information regarding identification mark of the female and her physical condition (as far as possible), the stage of heat period and the details of semen used, such as, motility of sperm, sperm density, percentage of abnormal sperms, the dilution and the period of storage of semen and the sexvigour of the male.

Applicability of artificial insemination in India

The research and field work done at this centre demonstrate the practicability of using artificial insemination and its possible development into a dependable system of livestock breeding in this country. But for some time yet, the ultimate objects of artificial insemination cannot be achieved, owing to various difficulties peculiar to India. These are, for example, (i) the conservatism of farmers and their prejudice against any new system, (ii) lack of adequate facilities for transporting semen, (iii) lack of knowledge regarding the normal working of the reproductive organs, such as, the duration of heat and the period between two successive heats in the Indian breeds of animals, (iv) difficulty in handling and inseminating many village cows and negligence on the part of the owners to bring their animals at the right time and (v) bad sanitation and severe climatic conditions.

In Russia co-operative organizations and State control of agriculture have made possible the application of artificial insemination on a vast scale. In all other countries, which have taken advantage of this method, organization have been mainly on co-operative basis. In Great Britain it has been decided that artificial insemination shall be developed as a national service, the centres being run by producer-controlled organizations, such as the cattle breeding societies, farmers' co-operative societies and the Milk Marketing Board. In this country it is obviously impossible, at the moment, to organize this practice on co-operative lines. India is a country of vast distances and of very few transport facilities. It is in the rural areas where difficulties will arise and it is there that artificial insemination service should be developed if any big results are expected. Besides, the or-

ganizations, at least in the initial stages, will have to be sponsored and financed by the Government.

If artificial insemination has to play the same useful part in the improvement of Indian livestock as it has done in other countries, it would be necessary to find how the practice will pan out under such peculiar difficulties of India and to remove them as far as possible. A note of warning regarding the hasty and uncontrolled development of this system may not, therefore, be out of place. Every attempt must be made to avoid pitfalls which might lead to disappointment and monetary loss and bring this system of livestock breeding into general disrepute. How useful it will be, only experience can determine. For these reasons the Imperial Veterinary Research Institute has opened four regional centres in the country. The experience gathered in these centres will help to guide the development of this system of breeding on a countrywide scale.

FARMERS AND CO-OPERATION*

By

C. Maurice Wieting.

National Council of Farmer Co-operatives.

Farmer co-operatives in the United States have been a powerful factor in raising the standard of living of the over 25,000,000 people who live on the more than 5,500,000 farms in our nation.

What is more, farmer co-operatives by improving the quality of farm produce and by the elimination of unnecessary middlemen, have long made it possible for city consumers to purchase higher quality farm products at lower prices.

No movement of the people in the world today offers greater promise of increasing mass buying power, both for the farm producer and for the ultimate consumer.

An American Tradition.

Co-operation has always been part of the tradition of the American farmer; neighbours have always helped one another with barn raisings, harvesting, threshing. This has made it possible for farmers to perform tasks efficiently which would have been impossible if they had worked alone or competed with one another. There are examples of farmer co-operation in the United States as early as 1810, though the greatest development has come in the past fifty years.

Most recent statistics of the Farm Credit Administration show that there are 4,390,000 members of 10,300 farmer co-operative associations, who in 1944 did a business of $5,160,000,000. Farmer marketing amounted to $4,430,000,000, and purchasing to $730,000,000, the latter figures rising to $1,010,000,000 when the purchasing business of marketing associations is considered.

The National Council.

Today, the National Council of Farmer Co-operatives speaks for almost 2,300,000 farmers who are members of 4,600 local co-operatives, which in turn belong to the ninety-nine regional organizations which are direct members of the National Council. It is the aim of the National Council to promote "the interests of co-operative business organizations of farmers in the United States by serving as a medium for; (*a*) a developing bonds of friendship, understanding and mutual helpfulness among farmer co-operatives; and (*b*) formulating and advocating policies of common concern affecting agricutural co-operation." It has consistently pursued these objectives throughout sixteen years, marked by the continued expansion and growth of the Council in which it has constantly helped farmers to organize and maintain co-operative association.

Because the co-operative movement is dynamic and growing it is being attacked by powerful business interests who have a selfish reason for wishing to monopolize farm business. The National Council of Farmer Co-operatives is taking the lead in defending the interests of all farmer co-operatives and in assisting small farmer groups.

Low Farm Income.

The average farm in the United States has but 87 tillable acres, and the average cash income per farm family was only $1,398 in 1939, the last normal prewar year. Even in 1944, it is estimated that average cash income per farm

*Borrowed from Ohio Farm Bureau News, December, 1945.

family was only about $2,000. With the recent end of the war, farm prices already have begun to decline, and they may fall disastrously again as they did in the 1920's.

"Full industrial employment can hardly be hoped for unless the purchasing power of agricultural population can be maintained at high levels." Randolph Paul, former Under secretary of the Treasury, said in a recent statement.

The need for agriculture, industry, labour and all consumer groups to work for free economy producing at a high level has long been recognized by the members of the National Council of Farmer Co-operative and other farm organizations.

Farmer co-operatives have made it possible for farmers in the United States to preserve the advantages of the family-owned and family-operated farm, while through their co-operative associations they have been able to secure the benefits of pooling their marketing and purchasing activities.

Bad Bargaining Position.

Acting as an individual, the farmer is at a disadvantage in the marketing of his product, he is forced to accept almost any price the marketing agency offers him—often far below true value.

Through marketing co-operatives farmers are enabled to combine their operations so they all benefit by the savings to be obtained by large-scale shipping, grading, packing, and bargaining.

Farmers have formed co-operative purchasing associations because individual farmers acting alone are forced to purchase their supplies at retail prices and sell their products at wholesale levels. Working together co-operatively, farmers now are able to pool their needs and secure feed, seed, fertilizer, oil, and all types of farm production supplies at wholesale prices.

Broad Advantages.

John H. Davis, executive secretary, of the National Council of Farmer Co-operatives, has summarized the benefits of farmer co-operatives in this way; "co-operative management is interested in maximizing farm production income through providing better and cheaper farm production supplies; facilitating economical and efficient distribution; reducing market gluts and shortages; minimizing spoilage of products; stimulating better grading improving varieties; developing better and cheaper transportation and storage; and encouraging fair competition."

Traditionally, the farmer has received about 50 cents of the consumers' food dollar, with the remainder going to processors and distributors. The costs of transportation and communication; processing and manufacturing; warehousing and storage; finance and banking; advertising and salesmanship; wholesaling and jobbing; and retailing are costs which cannot be eliminated, but they can be drastically lowered.

Margins Are Cut.

Farmer marketing co-operatives have largely done away with the evils that once were associated with the selling of farm produce and many unreasonable margins have been eliminated. However, farmers have just begun to extend their operations to the fields of processing and moving food and fiber through their co-operatives from the farm to the consumer.

Farmer marketing co-operatives are now giving consumers higher quality of goods at a fairer price because many of them have accepted the modern challenge of gathering, processing, and marketing the food and fiber farmers produce. Some of the unnecessary "toll gates" that have always stood between the farmer and his city brother have thus been eliminated.

Consumer's Benefit.

Consumers have benefited by lower per unit prices for many farm products, because of increased production stimulated by farmer co-operatives. Quality has been improved by grading and marketing practices which have been pioneered by farmer co-operatives. Highly perishable products have been brought to the market in an orderly manner.

There is no more powerful educative force in America today than the co-operative movement. Both on the farm and in the city, earnest groups of men and women are coming together to form co-operative associations which are founded on long and continued study of economic fundamentals.

The fact that every co-operative is a democratic organization operating for the benefit of its members, gives every member an opportunity to play a part in its operation. Annual business meetings of the 10,300 farmer co-operative associations do much to awaken farmers to the economic issues of monopoly, supply and demand, prices,advertising, grading, monetary control, international trade, and world peace.

ABSTRACTS AND REVIEWS

SOME NEW INSECTICIDES

In recent years three new insecticides have been perfected to combat man's insect enemies. Firstly : the powerful dichloro-diphenyltrichloroethane or D.D.T. which can be made cheaply in large quantities. In powder form it protects against body-lice and ticks. As a spray it remains toxic to flies for a long time. Second : a new, almost odourless repellant, which is used outdoors to keep insects away. It is a combination of three substances formerly used, and is three times more powerful than citronella. Third: aerosols, discovered in 1935, is a new method for making the insecticides now in use many times more effective. An aerosol is a suspension of fine particles in air or gas. In an aerosol the insect-killing substance is so finely divided that the tiny particles float in the air like smoke or fog, and ultimately find their way into every crack and cranny. Freon, commonly used as a refrigerant, is a harmless, nonpoisonous and inflammable gas, and is used as a solvent. Pyrethrin, D.D.T., and paradichlorobenzene dissolve in Freon and are used in aerosols. There is no waste as Freon maintains enough pressure to propel the solution into the air as long as a drop remains within the container.—B. Bartley

A NEW CHEMICAL WEED KILLER

Chemicals have been used for long for the control of deep-rooted perennial weeds. Of the chemicals so used arsenites and chlorates have been found to be most effective. But these are either poisonous to animals or highly inflammable, and also sterilize the soil. Recently American scientists have found chemicals which are in the nature of hormones which are very effective in the control of deep-rooted perennial weeds, and which do not have the disadvantages of such substances as arsenites and chlorates. The chemicals found most effective are two complex organic acids. The one commercially developed is *trychlorophenoxy-acetic-acid* and commercially known as T.C.P. When T.C.P. is sprayed on the plants, it is taken up by the leaves and translocated through branches down into the farthest root tip. The poison kills the foliage by destroying the chlorophyll, but the actual processes in the destruction of stems and roots are still not known. A dilution up to 1 : 1000 is quite effective in controlling the weeds.—A. K. Dhar.

FOOD FAMINE AND NUTRITIONAL DISEASES IN TRAVANCORE, (1943-44.)

Surveys by K. G. Sivaswamy, K. K. Chandy, Lt.-Col. T. S. Shastry, Dr. M. E. Naidu, Dr. T. V. S. Shastry, and 7 other doctors. Published by the Servindia Kerala Relief Centre, R. S. Puram Post, Coimbatore, South India.

This book gives a picture of the results of food shortage in various parts of Travancore from 1941 to 1944. Surveys were made, showing the number of deaths from diseases caused by starvation and describing nutritional diseases in Shertellay and other parts of the state. Three thousand died of the 15,000 people who emigrated to Malabar. The total number of excess deaths over the average of 15 per 1000 population was 1,33,000 during the four years 1941 to 1944. Diseases suffered were gastro intestinal disorders, diarrhoea, anemia, edema, rough skin, diseases of the liver and lungs, perepheral neuritis (beriberi), leg ulcers, rickets, and scabies.

There are detailed notes on family diets and tables of food values of their diets. The protein deficiency of tapioca is emphasized and the impossibility, due to poverty, of the people affording supplementary protein foods.

Causes of death are reviewed from various sources including parish records, surveys, and statements of children in orphanages.

The chapter on food shortage and state controls is very enlightening. Some interesting points made are inequality in food prices in British Cochin, the State of Cochin, and Travancore; the very poor quality of the grain offered by the state for sale to ration card holders; the large surplus profits made by the state; and the fact that the rice take-off was only 4 per cent of what was allotted to ration card holders. The recommendations made in this connection are valuable suggestions and worthy of wide publicity.

Methods of combatting pests of stored rice and wheat in the appendix should also receive much public attention—MIRIAM NULL

Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India)

THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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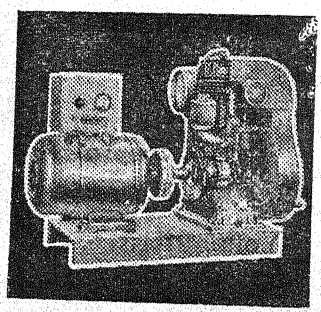

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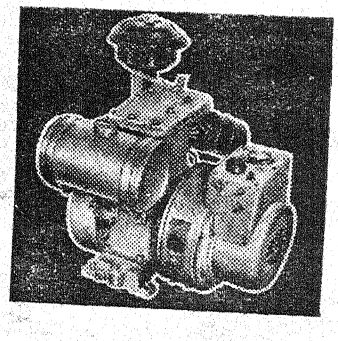

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THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

The ALLAHABAD FARMER is now approved by the Directors of Public Instruction in the United Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Reconstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools under their jurisdiction.

Subscription Rates

Annual subscription : India, Rs. 3 ; England, 4 shillings ; U.S.A., 1 dollar. Single copies 10 annas ; over five years old, 12 annas. Copies which are not received by subscribers will be supplied free of cost within six months of the month of issue. Thereafter single copy prices will be charged.

Unused portions of subscriptions cannot be refunded.

Advertising Rates

	Rs.	a.	p.
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Contributions

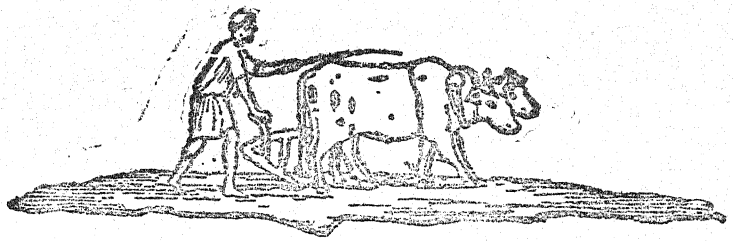
The ALLAHABAD FARMER is published in the first week of each alternate month commencing with the month of January. Contributors are requested to send in their articles at least one month prior to the next prospective date of publication.

Contributors will receive 15 reprints of the article published and additional copies at cost.

Publisher—The Allahabad Agricultural Institute, Allahabad, U.P. (American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U.P.

THE ALLAHABAD FARMER



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Editorial

Use Your Soil Wisely.

To speak of "the pressure of the population on the land" in India may be trite. The language is figurative because actually it is the demand made on the land for the production of crops for man and beast which is the 'pressure' implied. True, the average density of the population is high and it probably will continue to become higher. With such soil and climate as most of this sub-continent possesses it is but natural that this should be so.

If man and beast are to live well and happily it is essential that all due attention be paid to the soil upon which they have to live. This subject is so important that it should receive greater thought and attention. It simply is not possible to take out of the soil what is not there. The need for moisture during the uncertain monsoon seasons and, more especially, during the seasons of little or no rainfall is apparent. Therefore, it is gratifying that serious steps are being taken to increase the acreage in India under irrigation. Even though that acreage is the highest of any large country on the face of the earth it is not enough. Much more land needs to be given the blessing of sufficient moisture.

That blessing, however, may not be an unmixed one, because with the addition of moisture come other problems. There may be those of drainage, of the removal of alkaline salts, or of giving periods of rest to over-worked soils. These matters cannot be over-looked. In other words, the addition of moisture itself is, by no means, the great cure-all for the heavy pressure on the soil. This subject must be scientifically handled.

Just as important as the addition of moisture is the addition of organic matter such as decomposed manure, compost, humus, vegetable matter, or whatever one may wish to call it. Those who till the soil in order to produce crops ought to realise as perhaps they never have yet realised that vegetable matter must be conserved and supplied faithfully to that soil. This is one of the great lessons which the cultivator all over India, generally speaking, needs to learn. He needs to realise that vegetable matter in the soil serves to absorb moisture and act as a sponge, giving up that moisture as the roots of the plant draw upon it. That matter furnishes not only the necessary nutrients for the healthy growth of plants, but to a certain extent at least, through the return

of mineral matter, enables the soil to yield back in the crops produced the essential elements for healthy growth in man and beast.

The above-mentioned facts are fairly common-place. The Allahabad Farmer recommends, in these days of increasing pressure on the soil, that a nation-wide campaign to utilize all the available manure and organic matter, of whatever sort, for the maintenance of soil fertility should be waged. Such a campaign should be a positive and important part of the general 'Grow More Food' campaign. Instead of burning cowdung let there be a nation-wide campaign to produce quick-growing economic plants such as castor beans, *Sesbania Aegyptica* and others of similar characteristics which have fuel possibilities; and at the same time the slower-growing more permanent trees with fuel, fruit and timber possibilities. There should be a nation-wide observance of tree planting day, or days, at suitable times in the monsoon period to be observed as faithfully as the observance of the main religious festivals.

Along with this campaign there should be a similar campaign waged for the conservation of all manure and organic matter of whatever sort. Demonstrations of the best method or methods of preparing and storing, then applying this valuable material to the soil should be conducted vigorously throughout the whole countryside. The soil will soon begin to demonstrate the value of such consideration for it.

Let every one realise that the soil of India is her best material possession. It must be conserved and reclaimed wherever possible; its fertility must be maintained and increased. It may be necessary to use it intensively; but if so, let it be used wisely. Let it not be robbed nor depleted. Let it have its necessary rest (holiday) periods. Let not weeds infest it. Let every square inch be used to the best possible advantage. Let there be a fresh recognition of man's responsibility to the soil. Let India learn to value her soils and employ sound sense and science to conserve and utilize them.—J. L. GOHEEN.

Soil conservation is not a passive science, something that is to be applied only when there are signs of danger. For then it is too late. Soil conservation must be an everwatchful sentry responsible for the safety of the source of food production for the world, now and for all time.

Soil conservation becomes the basic link between nations for the betterment of people as a whole. It is a constructive force for binding together land users within community areas, and for building international good will and understanding. It will lead in the direction of world peace probably more than any other activity of mankind. We might very well recall this, then, when we come to reflect upon the fact that now, 1943 years after the birth of Christ, we have on our hands the most terrible of all the long history of wars. Something has failed somewhere. It may be that our costly failures across the centuries might have been avoided or minimized through international co-operation in matters pertaining to that kind of good land use which produces more food for people everywhere. Dr. Hugh H. Bennett, Chief of the Soil Conservation Service, U. S. Department of Agriculture.

AN ATTEMPT TO ASSESS THE ECONOMIC ASPECTS OF YOUNG CHRISTIANS SETTLED ON LAND NEAR UMMEDPUR, DIST. MORADABAD, U. P.

By

H. S. Azariah

Origin.—Early in March 1942, I had the privilege to attend as a visitor the ninth annual conference of the Reserch and Extension section of the United Provinces Board of Christian Higher Education which met at St. John's College, Agra. A sum of rupees fifty, given the previous year to the Allahabad Agricultural Institute for research in rural problems had not been utilized; and, therefore, on the recommendation of the Sub-Committee on Rural Problems the following resolution was adopted by the Board :—

"With reference to resolution IV of 1941, it was resolved to ask Mr. Azariah of the Agricultural Institute to attempt to assess the economic prospects of young Christians settled on land in the United Provinces, taking case studies of Old Boys of the Ummedpur Farm School and any other cases available as the basis of his study."

Ummedpur Farm School was specifically mentioned because it was a visit to that school by Mr. H. L. Puxley in connection with research and extension that resulted in his tour of the Christian colonies in Northern and Western India and the publication of his report of that tour in the form of a booklet, "Christian Land settlements in Northern and Western India". The present study may be considered a continuation of Mr. Puxley's study, for this is an ATTEMPT to answer some of the questions arising out of that study and to throw further light on the question of how far cultivation of land can contribute to the founding of the Rural Church on a sounder economic basis.

Method of Study.—It was felt that the best way to approach this problem is to obtain factual data and analyse them ; otherwise, whatever may be the findings, they would remain in the category of "someone's opinion". This means getting an exact picture of what is going on in Ummedpur. How far are these old Boys of Ummedpur Farm School successful as farmers? How much capital have they invested in their businesses? How do they compare with their non-Christian neighbours? An attempt will be made to answer these and other similar questions.

Two methods of study are open to us. The first is known as the "controlled method" in which the data is obtained from a few selected men who had been asked to keep regular day-to-day accounts. This will mean securing data from supervised accounts from few men. The second method is to get the necessary information from as many as possible and subject it to statistical analysis. This method (survey method as it is now known) perfected by G. F. Warren of Cornell University is now widely used in all farm business studies. Had these young men settled on land provided me with a detailed account of their farming business, I could have analysed those figures easily and used the first method. Although all of them had undergone an agricultural training and several of them were keeping accounts of some sort or other, they were not adequate. Therefore, the Survey method was adopted. This method, as mentioned earlier, does not control or influence the data in any way. It takes all available data both good and bad, and analyses them statistically to yield results. It is a cheap and quick method and can give very satisfactory results, if properly applied. Two types of errors creep in when this method is used—biased error and non-biased error. The biased error, as the name suggests, is due to prejudice and can be minimized by changing the questions or the method of asking for particular information. For example, if a farmer is asked to say how much of the grain he raised, was used at home during one crop year, he will make a " wild guess" which will be far from the

truth. Instead if he is asked how much he consumes at each meal, how much he feeds his cattle each day and how much he gives away as gift and as exchange for work engaged, one can calculate the amount "used at home" for one year; and this will be without bias. The non-biased error introduces an entirely different type of error. The extreme estimates will compensate if the number of observations is large and the average will be quite close to the true value. This fact is taken advantage of wherever actual records are not available and one can get only "estimates". The survey method commends itself especially in agricultural studies of a economic nature. The chief purpose of these studies is to know why certain farmers succeed, while others fail; and by using this method both successful and unsuccessful farmers are taken into account.

Presentation of Data.—A word of explanation may be given with respect to the presentation of the data. The classes of people who are benefitted by farm business studies are mostly those who have no knowledge of the science of statistical methods. Statistical methods, however, are indespensable in the analysis and interpretation of such studies. It is, therefore, logical to present the results in as simple a form as possible even though complicated and even laborious statistical methods might have been employed. For example, the relationship between size of farm business and income may be presented in three ways. Firstly, it may be expressed as $r = +0.564$, 'r" being the Pearsonian coefficient *or* co-efficient of linear co-relation. Secondly, the relationship may be stated as an equation in the form of $y = mx + b$, which is the regression equation representing the regression line. Thirdly, a graphic representation may be made (a scatter diagram). The data are plotted on a graph and if there were to be any relationship the dots would arrange themselves in a definite order. This form of presentation appeals to the eye. Lastly, a two-way table may be arranged to show the same relationship. The first two forms of expression are difficult to interpret by the lay reader; the graphic and tabular forms are easy to understand. In this study only tabular forms are used. It may also be useful to point out here that most of the relationships in the farming business, are joint relationships and although only linear relationships are indicated this fact must be borne in mind.

Procedure.—At the end of December 1942, I visited Ummedpur to obtain first-hand knowledge of the situation there. Ummedpur is about 12 miles south-west of Moradabad, and is a difficult place to reach these days. The bus service which used to connect Sambhal, Hatim Sarai and Moradabad had been discontinued due to lack of petrol. This pucca road goes within two miles of Ummedpur. One can, therefore, go by tonga from Moradabad, or go to Sirsi Mukhdumpur by train from Moradabad and get back 4 miles by bullock tonga or cart. The S. P. G. Farm School is attached to a 50-acre farm which is under the charge of Mr. H. C. Dutta, a very capable man who is putting into practice all he learned at the Agricultural Institute, Allahabad. An adjunct to the Farm School is the Nursery School in which children at a very early age are taken in. The importance and the contribution of the Nursery School to the Farm School should not be overlooked. As Mr. Dutta put it, "these boys develop a love for their equipment and an eagerness to work with their hands" and this persists with them even when they leave the Nursery School. The farm School keeps a careful account of the work done by each boy and estimates the money value of all work; and one anna per rupee thus earned is given to the boy as pocket money from which is met the expenses of hair-cutting and offertory. The rest is accumulated as savings, and is generally used for a complete set of new clothes when they leave the school. The school clothes supplied to them cannot be taken away and they have to be returned. In the early stages of the development of the school all

the money a boy earned was credited to his account and he was then charged for tuition and board. This left a credit balance for a few students and helped them to have enough money to bear the necessary expenses for starting a farm. Unfortunately, this method had to be discontinued as there were too many accounts in the red and the mission had to take the loss. The scheme is worth trying again in a modified form so that at least those who can earn enough to bear all their educational expenses in the school and are anxious to settle down on land may be given a chance to save what they can and thus acquire part of the initial capital needed.

There are 40 young men who have settled on land within a radius of 9 miles from Ummedpur. One or two are located as far as 25 miles from the school. But they all try to meet at least once a month in their school and discuss their problems and get help and advice from Mr. H. C. Dutta. Three of these young men came to Ummedpur to meet me and spent one full day with me. Mr. Dutta was good enough to cancel his engagements to devote all his time to answer my questions. Only those fields which were close to the farm school could be visited, but enough fields were visited to represent what was typical of that region and of those belonging to the old boys of the Ummedpur school. Homes of some of these young men residing in a village about 2 miles away from the school were also visited in order to get an idea of the standard of living of these men. I explained to Mr. Dutta the method I intended to follow in studying that group so that he could train someone who could collect the necessary data for me. This he did a few months later when I sent him a 30 page questionnaire consisting of 12 forms with full instructions for the one who was to collect data.

Climate and agriculture of the region.—Since this study refers to a particular place at a particular time it may be well to explain these at the very beginning. Moradabad may be located on a map 28°, 51' north and 78°, 46' east of Greenwich. It is situated on the right bank of the Ramganga and is at a distance of 868 miles by rail north-west from Calcutta. The average elevation of the district is 670 feet above mean sea-level and the land slopes from north to south (767' to 581'). The soil is alluvial in which boulders of stone occasionally occur. *Kankar* also is abundant in certain places. *Reh* is also found and occurs in patches in some fields occupied by the Old Boy's of Ummedpur School. Generally speaking, the land under study, is more or less level with a slight slope where sheet erosion has occured. The climate is said to be congenial the atmosphere being clear and dry. The prevailing winds are from east as well as from west, the former being more frequent. Hot winds blow very irregularly beginning from the middle of April or the beginning of May. The annual mean temperature is 75°F with a minimum of 56°F in January and a maximum of 90°F to 92°F in the latter part of May or beginning of June. Moradabad has very cold nights in winter and has seen 22°F in 1839. Rains set in about the 10th of June to early part of July and cease about the end of August or early in September. The average annual rainfall for the district varies from 40 to 35 and Moradabad town and its neighbourhood gets 36". This study is concerned with the period June 1, 1942 to May 30, 1943 and during this period, Moradabad had good rains during the first half of the season and about half its normal during the 2nd half. The normal rainfall from 1st of June to 20th of September is 34.56" of rain. From the 1st of October, 1942 to the end of February, 1943, Moradabad received only 2.12 inches of rainfall although the normal for that period is 3.88".

The important crops in that region are rice, wheat, barley, *bajra*, *juar*, maize, gram, pulses, sugarcane and cotton. The year under consideration was very favourable both from the point of view of climate and from the point of prices of agricultural commodities. The out-turn of the rabi crop was officially estimated 80 per cent of the normal. The prices of agricultural

commodities were generally very high and helped the farmer to get a good income. If we consider only the most important crops grown by the young men under study, the prices were, on the whole, 127 per cent above the prices that prevailed in August, 1939, that is, just before the outbreak of World War No. II; and they were 120 per cent above the prices of the previous year as shown in the table below :—

	Rice	Wheat	Barley	Gram	Arhar Dal	Til	Linseed
August 1939 ..	100	100	100	100	100	100	100
March 1942 ..	138	184	124	118	127	160	106
March 1943 ..	240	223	264	210	269	208	173

High price level—High prices is one of the reasons for the success of the farmers presented in this study; and this important fact must be borne in mind in interpreting the final results.

The men studied—Out of 40 old boys of Ummedpur Farm School who are farming, data was collected from 31; but six of them could not be used as five of them had left farming to join the army and one questionaire was not fully filled in. This study, therefore, concerns only 25 young men or 71.4 per cent of the Old Boys now farming near Ummedpur.

The average age of these men is 26 2 years and ranges from 18 to 35 years. Seventeen or 68 per cent of them are married; of these 11 have children, the average number of children per family being 3.4. Seventeen of them have near relatives living with them and the average number of such dependants is 1.1. Only one married and another unmarried had no dependants whatsoever. The average number of experience years of was 8.8 and this varied from 1 year to 18 years.

Their farms are one to 10 miles from the school. The nearest railway station is on the average 5.8 miles away from them and nearest pucca road, 3.8 miles. Postal communication is available, the nearest Post Office being on the average about 4½ miles away from them. The Police Station also is about the same distance.

The majority of them (68 per cent) are occupancy tenants and the rest have in addition some land under non-occupancy. One man has half his holding under zamindari system of tenure. The average holding is 7.80 acres with a standard deviation of 2.76 acres. Fifty-two per cent of the farms are fully irrigated and 12 per cent partly irrigated.

The important crops grown by this group in the order of importance according to seasons are (*a*) *Kharif*, bajra, urad, juar for grain, til, paddy and juar for fodder. (*b*) *Rabi*, wheat, gram, arhar, mustard and barley. Although this is a sugarcane tract only one grew that crop.

Subsidiary income—All of them had a pair of bullocks excepting two who had 2 pairs. Out of the 25 men, only 4 (20 per cent.) kept 1 cow each ; ten men had one buffalo each ; and 1 man, 1 cow and a buffalo. Of these, only one man sold fluid milk and 4 sold ghee. Two farmers consumed at home the milk and ghee that was produced on the farm. Only four kept a few chickens for home consumption. Sheep and goats were not reared at all.

Four men worked outside in their spare time: three let out their bullock carts on hire and one worked on a handloom. It looks certainly, a profitable business to let out idle bullock carts and oxen. But all men living in a restricted locality cannot profitably do this.

Farm Power:—As could be noticed from the appendix, the farm power was a weak point in their farm organization. On the average 1 pair of bullocks was taking care of 7.8 acres Most of them had an "excess" of power. Whether a farmer had 3½ acres or as much as 15 acres he kept one pair of bullocks.

In other words the man who managed his 15 acres with one pair of oxen was using his draft power far more efficiently than the one who utilized a pair of bullocks for only 3½ acres. The bullocks in the first case were doing 4 times the work the latter were accomplishing. Incidentally, this young man who was managing his 15-acre holding with only one pair of oxen had the highest labour income (Rs. 981-8-4). His labour earnings were Rs 1,458 which is equivalent to a salary of about Rs. 120/- a month. This excludes the earnings of his family members and the interest at 5% on his capital.

Income:—There are several methods of measuring the success of a farm business; but for the purpose of this study only three were used. First of all, the data were analysed to find out how much these young men were getting for their labour for one year (labour income); secondly, how much the farming business pays for the family as a unit (family earnings); and thirdly how the remuneration from farming compares with the urban wages (labour earnings). The average labour income for the group was Rs. 256-9-8; the family earnings Rs. 535-11-10 and labour earnings Rs. 469-15 8. That is, the farm was paying them on the average Rs 39-1-10 besides providing a free house to live in and supplying farm products for the entire family.

Size and income:— A few important relationships may now be presented. The labour income of these men increased as the size of the farm increased.

Average size	Labour Income.
4 43 Acres	Rs. 218-0 0
7.00 "	Rs. 261-6 0
10 09 "	Rs. 359-12-0
12.00 "	Rs. 432-0-0

This relationship is noticed in all farm business studies in the West; and a few unbelieving arm chair investigators have been, and still are, questioning this universal law of farm-management.

Experience and Income:—The science of farm management gives precisely the same information that one can get from years of experience. To be effective there must be a number of farm management studies which show why some farms succeed while others fail in a certain locality or region. The information these studies give must be used as "standards"; and ones own achievement in managing a farm must be accurately measured by the help of carefully kept accounts. This will help one to get in a very few years the same results as that of a man with many years of experience. In absence of reliable farm management studies in this country we should expect a direct and pronounced relationship between experience in farming and income

Average years of experience.	Labour Income. Rs. a. p.
2.17	112 10 4
6.13	221 13 5
11.80	347 8 3
16 67	371 2 3

Irrigation and Income:—That irrigation or lack of irrigation will also tell in the labour income is the usual assumption.

		Rs. a. p.
Non-Irrigation...	7.6 acres.	224 13 6
Irrigation ...	8.65 acres	296 15 3

The married people seem to do much better than the unmarried! The labour income of those who were married averaged Rs. 630-12-10, while those of the unmarried Rs. 333-11-7. All the difference is not due only to marital status. This is a joint relationship between area, experience and marital

status. The average experience of the married group was 11.6 years and their holding 8.2 acres while the unmarried had only 3 years of experience and a holding of 7.0 acres.

As mentioned earlier, it must be remembered that these factors do not act independently of each other. They act jointly. It was found that for this particular group, area and experience jointly accounted for 83 per cent. ofthe variation in income. The remaining 17per cent was caused by other factors, a few of which are mentioned above (irrigation, subsidiary income, marital status, etc)

Comparison with neighbours:—In order to compare this group of young Christians with non-Christian neighbours, it was felt at first that the standard of living might be profitably employed. When this was attempted there were many difficulties. Firstly, the standard of living itself is very difficult to measure. Several ways have been suggested especially in the United States. All those methods are not quite suitable under village conditions in India. For example, one may try the number of durable goods one has. The possession of a chair, a table, or a phonograph may be used as indicators of a higher standard of living. At least in the villages near Ummedpur the possession of these thing will mean copying the "barra" sahibs. They are not considered as convenient material possessions, but rather as the exhibits of ones arrogance with the result that the possession of these will mean incurring the displeasure and hatred of non-Christian neighbours. Actually, one of the men's houses was set on fire, just because he tried to indulge in it. Because of all this, no one dares invest his money in these forms of wealth. Clean house, healthy, good sized animals and the size of the grain tin, these, rather than chairs and phonographs, may be used as indicators of a higher standard of living. Judged this way these young Christians are far superior to their non-Christian comrades. One cannot but notice the contrast of clean house ; clean, healthy and beaming children to those of the non-Christian neighboures who surround them.

In conclusion, we might say that these young Christian men settled on land are doing very well indeed. Several of them are getting a labour income of over Rs. 500, while one had made Rs. 981. The earnings for the family as a whole were between Rs 1,000/- and Rs. 1,500/-. The size of their farm business and experience in farming are two predominent factors which affect their income. Subsidiary income and irrigation also favourably affect profits. Compared to their non-Christian neighbours, these young Christian men are on a higher plane mentally, physically and spiritually. There are evidences that young men of this category can certainly help a great deal to establish the Indian Church on a sound economic basis.

Caution is needed in interpreting the results given in this study. The results will hold good for this particular group only. Statistics will not uphold, any generalization made from this. That is, we cannot definitely state that these relations will hold true for other localities. In studying the impressive incomes these young men had made, one must not forget the most important factor that affects farm profits, namely, the general price level. In a time of rapidly rising price-level, farmers flourish. In general, they receive for their products a higher price than what they pay for go ds they buy. The year of this study was a favourable one, for farmers.

Few suggestions:—Although the terms of reference had been only "to attempt to assess the economic aspects of young Christians settled on land near Ummedpur," I trust it will not be entirely irrelevant to make a few suggestions. Firstly, regarding the young men themselves. Every effort must be made to enlarge their farm business. This need not necessarily mean increasing the area of their holdings. Attempts may be made to use his time efficiently and that of his oxen effectively. Subsidiary cottage industries and

subsidiary enterprises will do the same trick as large areas. Just what these should be, I am not in a position to say. It depends so much on the local conditions. The possibility of setting up a co-operative society to solve the draft power may be investigated. Maintenance of one pair of oxen just to cultivate 3 to 5 acres is a heavy burden on the farmer with a small holding. Accurate but simple accounts which can yield very useful information in organizing their farm effectively must be tried. The present records are insufficient. If an annual analysis of their business individually and collectively could be made, they would be benefited greatly.

Secondly, I surmise this study was sanctioned with the purpose of finding out the possibilities of settling young Christians on land thereby improving their economic status and putting the indigenous Church on a firmer independent footing. While more information is needed for any generalization, I am inclined to believe from what I have seen there in Ummedpur that this is possible. During the Christmas of 1942, all the supplies needed for the Christian community dinner were supplied gratis by the well-to-do young men of this group. The question why Christians settled on land in some other places have not done so well may be legitimately asked. I attribute the success of the Ummedpur experiment in a large measure to two outstanding features. Firstly, a thorough training is being given before these men take to farming. Secondly, a vital and very effective link is being maintained between the school and its old boys, who take their practical problems back to the school and get counsel and advice. The school in turn gets the advantage of knowing the problems in actual farming. It also acts as a vital agency in bringing together the members of this group. The success of this set-up is largely due to the untiring efforts of Mr. H. C. Dutta.

Two importat problems will have to be faced in any effort made to settle young Christians. The problem of land and the problem of capital. I believe sufficient land must be made available for young men who desire to settle on land. There seem to be four ways open to us. 1. The local church-body or mission may acquire land 2. Well-to-do Christians individually become zamindars so as to let it out to young Christians. 3. The good-will of non-Christian landlords may be sought. 4. Some sort of Land Trust Company may be formed by the pooled resources of the Christian community. Only trained men must be allowed to rent such land and they must be given an opportunity to climb the agricultural ladder from tenancy to ownership. With respect to capital, credit facilities must be made available where a person can get cheap credit. To a farm school, I would commend a modified Ummedpur plan, whereby a promising student is given a chance to save and acquire part of the capital needed later in his life.

Lastly, as I made this study it has been forced upon me that more co-operation is needed between various Christian denominations that are working in the rural field, specially at this time, when great challenges are thrown at Christianity and at a time every effort is being made in this country for church unity. Here is an S. P. G. Mission school within easy reach of a very famous Presbyterin Agricultural College and yet, apparently, no connection and interest exist between them. I believe Ummedpur area may be a very useful extension area of the Agricultural Institute. Effective useful propaganda may be made to these young men with respect to better varieties of crops and improved implements. The department of Agricultural Economics is not seizing a golden opportunity. These young men are eager and co-operative. Exact information with respect to farm business under village condition may be obtained from these men. Some simple accounts may be suggested. Blank forms may be supplied and they be asked to keep records on them. At the close of the year the Institute may help to analyze the figures so obtained. This will help these young men and it will also help the Institute. It is time

(*Continued on page* 74.)

Serial number.	Age	Experience	Marital Status	Area	Irrigation	Buildings	Equipment	Live Stock
1	23	7	m	10	-	501 8 0	181 0 8	407 8 0
2	20	2	Un	6½	-	229 0 0	114 11 4	75 0 0
3	32	13	m	6½	+	49 8 0	111 6 8	145 0 0
4	34	14	m	7	+	56 0 0	113 15 0	67 8 0
5	30	5	m	3⅓	+-	52 0 0	128 10 8	107 8 0
6	32	10	m	3½	+-	286 8 0	109 13 8	192 8 0
7	17	1	Un	7	+-	89 8 0	121 0 0	35 0 0
8	32	15	m	11	+	391 0 0	66 15 4	102 8 0
9	25	7	m	10	+	80 8 0	84 12 8	82 8 0
10	26	10	m	12	+	298 8 0	118 2 0	317 8 0
11	20	5	Un	11½	-	230 0 0	90 3 4	72 8 0
12	30	5	m	7⅓	-	136 8 0	14 7 4	92 8 0
13	35	15	m	4	+	289 0 0	161 7 4	140 0 0
14	25	6	Un	6	+	170 0 0	62 11 4	125 0 0
15	35	20	m	7	+	219 8 0	115 13 4	205 0 0
16	18	2	Un	10	+	123 0 0	87 11 4	160 0 0
17	20	6	m	12	+	541 0 0	109 4 6	325 0 0
18	25	8	m	6½	+	110 0 0	100 2 8	170 0 0
19	30	12	m	5	+	70 0 0	110 8 8	62 8 0
20	30	16	m	15	+	981 8 0	89 0 8	170 0 0
21	20	4	Un	5	-	171 0 0	16 12 0	100 0 0
22	19	2	Un	5	-	121 8 0	130 13 8	60 0 0
23	19	2	Un	5	-	102 8 0	9 14 6	39 0 0
24	35	18	m	8	-	293 0 0	112 8 8	60 0 0
25	32	16	m	10	-	410 8 0	162 3 4	300 0 0
Total ..	654	221	17m 8Un	195	13+ 9- 3+-	6,003 0 0	2,544 2 8	3,594 0 0
Average..	26·2	8·8	.. 68% 32%	7·80	.. 52% 36% 12%	240 1 11	101 12 3	143 12 2

F & supplies	Capital	Receipts	Expenses	Labour Income	Labour Earnings	Family Earnings
40 8 0	1,130 8 8	1,581 1 4	1,02 0 0	477 9 0	673 13 0	
34 0 0	452 11 4	442 6 8	200 0 0	265 0 10	435 4 10	
21 0 0	326 14 8	552 13 4	289 0 0	247 7 10	422 11 10	558 11 10
25 0 0	262 7 0	432 2 0	186 10 0	232 1 11	387 1 1	
23 0 0	311 2 8	438 0 0	127 2 8	295 4 4	473 12 4	
28 0 0	616 13 8	358 7 4	135 0 0	192 10 0	412 10 0	
21 0 0	266 8 0	205 8 0	149 0 0	43 2 10	221 8 10	281 8 10
27 8 0	587 15 4	407 14 8	365 0 0	13 8 4	147 8 4	207 8 4
16 0 0	263 12 8	347 9 4	277 0 0	57 6 4	109 14 4	245 14 4
44 8 0	778 10 0	1,075 4 0	498 0 0	538 5 1	1,088 5 1	1,224 5 1
13 0 0	408 11 4	313 0 0	122 4 8	170 4 6	288 4 6	
12 0 0	255 7 4	229 14 8	109 8 0	107 10 4	172 7 1	
48 0 0	638 7 4	630 14 8	253 8 0	340 7 11	672 7 11	
12 0 0	369 11 4	167 6 8	119 0 0	29 14 11	90 6 11	150 6 11
36 0 0	596 5 4	453 2 8	363 0 0	60 5 6	203 11 10	
48 0 0	418 11 4	602 14 8	387 0 0	195 8 11	330 2 6	466 2 6
52 0 0	1,027 4 6	957 1 0	467 5 0	438 6 2	904 6 2	1,040 6 2
52 0 0	412 2 8	532 5 4	314 0 0	198 4 7	392 4 7	452 4 7
48 0 0	291 0 8	731 1 4	189 8 0	527 0 6	593 8 6	653 8 6
92 0 0	1,332 8 8	1,511 1 4	463 8 0	881 8 4	1,458 0 4	1,518 0 4
20 0 0	337 12 0	245 8 0	212 0 0	11 14 0	94 6 0	230 6 0
22 0 0	334 5 8	479 3 4	289 8 0	172 15 10	461 7 10	597 7 10
12 0 0	163 6 6	226 5 0	230 15 1	12 12 6	84 3 6	220 3 6
40 8 0	506 0 8	553 1 4	353 8 0	174 4 6	572 12 6	632 12 6
42 0 0	914 11 4	1,187 6 8	485 0 0	656 10 11	1,058 2 11	1,194 2 11
833 0 0	12,974 2 8	14,661 9 4	..	6,415 0 11	11,749 7 7	69'73 14 2
33 5 1	518 15 6	586 7 5	..	256 9 8	469 15 8	386 15 3

SOME OBSERVATIONS ON THE BETEL-NUT (*ARECA CATECHU*) PALM.

By

SUDHIR CHOWDHURY.

The betel-nut palm (*Areca catechu* L.) is met with throughout the hot damp regions of Asia and the Malaya Islands. It is cultivated exclusively within the moist tropical tracts that fringe the coast of India and practically within a belt of land that does not extend inland for more than 200 miles. It rarely ascends to altitudes of 3,000 feet and gradually disappears, even from the littoral area, as localities are entered where the duration of the dry hot months equals or exceeds the monsoons. Usually, it is seen as a garden plant, five or six or a dozen palms at most being found around homesteads. But, occasionally and in certain localities especially of southern and western India and of Assam and of Burma, where the soil and climate may be exceptionally favourable, it is grown in special gardens along with cocoanut, plantain, orange, mango, etc., and either with or without the *pan* (*Piper betle* L.) climbing on the palm stems. Lastly, in eastern and northern Bengal and some portions of Assam its cultivation has assumed still greater dimensions. In certain localities of these tracts regular plantations of 5 to 20 or even 100 acres occur and at such frequent intervals that they might almost be said to constitute a distinct agricultural feature scarcely less important than the combined crops raised on the intervening portions of the country.

Origin and History :

The original habitat of the betel-nut palm is unknown, but Beccari considers that a Philippine variety, *Areca catechu* var. *silvatica* possibly represents the true wild plant of that widely cultivated species; for in the Philippines various forms of *Areca* occur so closely related to *A. catechu* as to afford good ground for belief that it was in those islands that *A. catechu* finally assumed the specific characters it now exhibits. In support of this view he observes that in no other part of southern and eastern Asia or Malaya is any species of *Areca* to be found which in any way approaches *A. catechu* in specific characters, whereas in the Philippines an entire group of species exists closely related to it.

Ridley mentions that it was cultivated in Malacca before 1593 and it is mentioned in a Chinese work dated 140 to 80 B. C. under the name *pinlang*, which was evidently a perversion of *pinang*, which as a name for the tree is confined almost entirely to the Malaya Peninsula and Sumatra.

The earliest historic reference by a European to the habit of chewing betel-nut occurs in the writings of Marco Polo (1298 A. D.).

The best known vernacular names for the nut are, *supari*, *hopari*, *gua*, *gaya*, *kasaile*, *mari*, *tambul*, *pokavaka*, *oka*, *kamugu*, *adike*, *kimsi*, etc.

Uses :

The nut is a masticatory of great antiquity with all Asiatic races. To the taste the nut is astringent and slightly acid; it possesses also narcotic and anthelmintic properties. These properties are due mainly to the alkaloid *arecoline*, but three other closely allied alkaloids have been isolated. The alkaloids are said to occur in the light-coloured endosperm and not in the dark brown or red portions which contain the colouring matter.

For chewing purposes a small portion of the fresh or dried nut is taken and wrapped in a piece of leaf of the betel vine (*Piper betle*) together with a little lime. In addition there may be added according to taste gambier, tobacco, cloves, cardamoms or *kossa*.

The powdered nut owing to its astringent action on the gums is used as a dentrifice and in veterinary practice for the expulsion of worms in animals.

The nut is symbolical of festivity ; it is accordingly a fit offering for the gods and is an essential at the betrothal ceremony. Further, from the most ancient times the presentation of *pan* has been the polite termination of ceremonial and other visits.

Vegetative Characters :

Areca catechu is a graceful tall-stemmed palm often reaching a height of 60 feet. Its stem is cylindrical, 5 to 8 inches in diameter, and ringed distinctly from the base upwards by the scars of the fallen leaves. The stem is green when young, but assumes a greyish colour with age ; it is slender in comparison with its height, but being tough and strong it is not readily broken by the wind, and further it is able to maintain itself in an erect position even in fairly soft soils by means of numerous strong roots which grow out above the base of the stem as well as below in the soil. The crown of leaves is compact with a diameter of about 8 feet. The leaves are pinnate, from 4 to 6 feet long, with a long sheathing base which completely encircles the stem. The leaflets are numerous, 1 to 2 feet long and 1 to 1½ inches wide, some of which may remain joined together ; they are fairly rigid and form a somewhat dense, flattish surface.

Flowering :

When grown under the best conditions the palm often commences to flower when it is about 4 years old. The first inflorescence to open may occur on the stem at 4 to 6 feet from the ground in the axil of the lowest attached leaf. Each inflorescence or spadix is closely covered by a leaf-sheath until a few days before it is ready to open. Further, the spadix is completely enclosed in a sealed, double boat-shaped, flattened spathe about 2 feet long and 7 inches wide in its broadest part. The inner and upper side of the spathe is much thinner and weaker than the lower and outer side, so that the expanding spadix early bursts the spathe open along its upper side in a central longitudinal line and frees itself.

The spadix is shortly stalked, 1½ to 2 feet long, with numerous branches and unisexual flowers. Each secondary or tertiary branch bears one to several female flowers near its thickened base, whilst an abundance of male flowers are produced on special filiform branches, 6 to 10 inches long, which arise below and extend beyond the female flowers. The male flowers are arranged in pairs in two rows along the upper part of these thin branches, but occasionally one or two of them are found at the base of and beside a female flower.

The male flower is small, 1/8 inch long, sessile, triangular, white with three minute sepals and three larger stiff, lanceolate petals. The stamens number six and contain very minute, colourless, pollen grains. The rudimentary ovary is trifid and slightly longer than the stamens.

The female flower is ½ to 5/8 inch long, sessile, with three broadly imbricate green sepals about as broad as long and three ovate petals. At the time the flower is receptive, the petals are creamy white and about one-third longer than the sepals There are six minute flattened staminodes whose bases are joined together and encircle the base of the ovary.

The ovary is surmounted by a thick trifid stigma which is situated immediately below the small opening formed at the tip of the flower by the petals.

Both the male and the female flowers are very fragrant.

Male and Female Flowering Phases:

The male phase begins immediately after the spadix frees itself of the spathe. The male flowers commence to open at the tip of each slender male branch and continue backwards towards its base in a fairly regular manner until all the flowers are exhausted. This phase lasts from three to four weeks.

Near the end of the male phase the green petals of the larger female flowers commence to lengthen and to change their colour. After the last male flowers have opened, the petals of the female flowers open slightly at the top, and soon after, the flowers become receptive and remain so for perhaps two or three days. Although the female phase definitely starts after the close of the male phase, the commencement of it, reckoning from the time of the opening of the flowers, has been found to vary considerably in different trees. In some instances the flowers opened the day following the close of the male phase, whilst in others up to eleven days elapsed before they opened. The average time, however, was about four days.

The male flowers are visited by various small bees and other insects which appear to collect or feed on the pollen only, but no insect visitors have been seen on the female flowers. It would appear certain that the pollen is carried by the wind to the female flowers which, under the circumstances related above, are normally cross-pollinated, and that only under exceptional circumstances can the flowers be pollinated by pollen from the same tree. This is an important point because it shows that much difficulty would be experienced in obtaining pure races of the betel-nut under ordinary conditions; however, it has been observed that young trees when growing rapidly under good conditions sometimes develop spadices in such quick succession that the male phase of the last opened spadix overlaps the female phase of the one immediately below so that self-pollination is possible.

Flowering Seasons:

The seasons for flowering and fruiting may be said to be distributed throughout the year. The flowers that form in January will ripen fruit in October; the flowers formed in March will fruit in December and January. The harvesting period is from October to the beginning or middle of January, but occasionally, the new flowers may begin to form in December or January on trees from which last year's fruits have not been collected.

Fruiting:

The fruit takes about eight months to ripen, and when ripe it is orange-yellow or yellow in colour and consists of a thick fibrous outer layer, the pericarp, which encloses a single seed or nut. The seed is inserted considerably above the base of the fruit. The hard endosperm which fills the seed is traversed by dark wavy lines which give it a marbled appearance resembling the nutmeg. The red or reddish brown markings are due to the infolding of a dark inner layer of the seed-coat into the light coloured endosperm. The embryo situated at the base of the seed is fairly large and conical in shape.

Under suitable conditions the palm is reputed to bear profitable crops for at least 40 years. Watt states that in Bengal the fruiting life of a tree may be put at from 30 to 50 or 60 years after maturity, and the total life of tree at from 60 to 100 years. In Bombay the palm is known to fruit freely for 30 to 40 years and there is a popular belief that it is sometimes profitable much longer.

In Malaya the palm is in fruit throughout the year; still, as in India, the period of largest production is from November to February, which indicates that more rapid growth and flowering takes place in the wet months April to July

than in other periods of the year. It is no uncommon sight to see a palm bearing seven or more spadices with flowers and fruits in different stages of development, but the usual number is four or five when in the full bearing and three to four or less in old palms.

The number of fruits borne on a spadix is very different in particular varieties and may vary from 50 to 100 in certain large types to 150 to 250 or more in some of the medium and small forms.

Varieties :

In common with many other species of useful plants that have been cultivated a long time, the betel-nut palm has produced many varieties.

As observations on the flowering of the betel-nut palm have shown that the flowers are normally cross-pollinated and that in all plantations and gardens there are numerous types it will be realised that in the absence of breeding experiments, it is an almost hopeless task endeavouring to decide which of the large number of forms are distinct varieties or races and which are merely unstable hybrids ; however, as certain types commonly occur in plantations and have been given names by the local growers, these will be described. They are all used for chewing purposes.

(*a*) *Round, Big* : A large globose-ovoid fruit. The nut is roundish, rather broader than long, large, dark-grained, and soft in the centre.

(*b*) *Round, Small* :—A medium sized fruit, ovoid pointed. Nut small round and close dark grained.

(*c*) *Convex shaped* :—A fairly large fruit, ellipsoid-ovoid, pointed. Nut large, ovoid-conical, coarse grained with a large proportion of light coloured endosperm.

(*d*) *Pointed Top* :—Medium size, ellipsoid-ovoid with a distinct acuminate point. Nut fairly large, broadly ovoid-conical, dark-grained.

(*e*) *Narrow Base* :—Small, ellipsoid, distinctly tapering to the base. Nut small, rounded, rather coarse grained, soft and white.

No type can be relied on to breed true for the reasons already given, but a large proportion of palms bearing satisfactory crops of good-sized nuts is likely to be obtained if a selection of fruits from individual trees is made.

Harvesting and Drying :

The bunches should be cut only when the fruit is ripe, but it was observed in nearly every place where harvesting operations were in progress that quite a large proportion of unripe, partially ripe, over-ripe and decayed bunches of fruit were collected and mixed with the fully ripe sound ones. This indiscriminate method of harvesting depreciates considerably the value of the produce because the nuts from unripe fruit shrivel up badly in drying and have a dark colour whilst those from over-ripe ones are most difficult to separate from the husk without damaging them.

To prepare the betel nut for market it is necessary thoroughly to dry the fruit. It is very difficult to separate nut from husk when the fruit is newly gathered, but when dry, the husk comes away quite easily. Two methods of curing are usually followed :

(*i*) The fruit is split into two halves with a *jati* (a chopping knife) and laid out on a open space in the sun, split side uppermost. After two or three days'

(*Continue on page* 74.)

THE CO-OPERATIVE FARM.

Is It The Solution of India's Agricultural Problem?

By

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Reinforcing the conviction of many agricultural leaders, the war has brought a new interest in the necessity of improving Indian agriculture. The recent food shortages, including the famine in Bengal, have brought sharply to the attention of the public the fact that India is normally a deficit country in food production, even though the food consumption per person is low as compared to that of other countries. The various plans for economic development of the country have included the improvement of agriculture. The "Grow More Food" campaign has also helped to bring to wide attention the need for improving the production of food crops.

In considering ways of improving Indian agriculture, it is natural to look at the agriculture of other countries and to try to see in what way their agriculture has been modified in recent time. It is reasonable to consider how and whether the changes made in other countries can be applied to India or not.

The most striking change in American agriculture and, to only a slightly less degree, in the agriculture of European countries, has been the substitution of mechanical power for animal power, the use of tractors instead of horses or bullocks, and the use of large size animal-drawn implements. More recently, the mechanisation of Russian agriculture has been widely publicised and many writers have pointed out the advantage this mechanization has been during the war years. Since the most striking difference between Western and Indian agricultural practice is that of the power used, it is quite natural to assume that somehow, the thing needed to improve Indian agriculture is the introduction of the tractor and its related implements.

Obviously, the tractor and plough which work an acre an hour and cost Rs. 5,000 to Rs. 7,000 are not suited to the use or needs of the farmer having 5 to 7 acres, but that is the tractor which is available. In the Western countries, the farms are large. In India few as yet have come to accept the necessity of releasing large numbers of men from agriculture as has been done in the Western countries so it is reasonable to try to find some way by which the present farmers can remain on the land and still have the supposed advantages of using tractor power. To this the obvious answer seem to many to be the co-operative farm where enough farmers put their land together to make a big farm and all work together. So we have all sorts of people recommending the co-operative farm as the way Indian agriculture must be modernised, even ready to say that there must be, if necessary, some degree of compulsion to bring it about. Let us examine in some detail what is involved in such a proposal, where its adoption would lead us, and try to decide whether it would be a good thing or not after such an examination.

In the United States, the tractor and its associated implements are called "labour saving equipment." This implies that the objective in adopting them is the saving of human labour, the reduction of the amount of human time required to accomplish a certain job or the reduction of human effort or both. This is definitely the result secured by using the tractor. In India, people more often think of the tractor in terms of doing things which they think cannot be done by animal power. The *kind* of work done, rather than the *quantity*, is in mind. Of course, it is realised that one man with a tractor can do much more than a man and a pair of bullocks. I think, however, if 100 men were asked individually why they thought the tractor would be helpful in India, a majority would refer not to the amount but to the kind of work it would enable the user to do—deep

ploughing, uprooting of grasses, the reclamation of waste land and such things. Contrary to this belief, the main advantage of the tractor and large power operated implements is the *amount* of work it enables a man to do. There are very few operations which cannot be done with bullock power quite satisfactorily so far as *quality* of work is concerned. The rate of accomplishing a given job may—usually will be—much slower but the quality is not necessarily different. There is no question that there are times when being able to do work quickly, to finish it in a short time, is a distinct advantage and may result in better quality of work. Many of these times are when speed of doing a job at one time helps to offset the disadvantage of not having done the job earlier when it should have been done. Sometimes the power of the tractor makes possible the doing of a job at a *time* when it could not well be done with bullocks but often the same job could be done effectively with bullocks at another time. This, of course, assumes that the implements used with bullocks will be as suitable to the job as will those used with the tractor, that we are talking of the use of "improved" implements, not the use of the old wooden plough. There are definitely several kinds of work which cannot be done at all with the wooden plough but which can be done with improved implements.

As implied earlier in this paper, comparatively large areas are required for the economical use of the tractors now available. It is generally considered that less than 75-100 acres will not justify the investment in a tractor even with high priced labour except possibly in the case of specialty crops giving a high return per acre when a somewhat smaller acreage may justify a small tractor. The so-called garden tractor has not been used to any large extent as the sole means of cultivating small farms but rather as a small unit for the supplementary work on larger areas or occasionally for part-time farming on small areas. If we accept the figure of 5 acres as representing a common size of farm in the Ganges valley, it would, therefore, require the combination of 15-20 holdings to make on one which a tractor would be considered economical.

It should also be kept in mind that with tractor power and implements, a single man can and does in America handle 100 acres or more of cultivated crops per year under climatic conditions less, rather than more, favourable than in India. Therefore, in order to get an area economical for the use of a tractor, which could then be handled by one man, it is necessary to combine the holdings of 15-20 men. What shall we do with the extra men and how are they to be occupied if we are to keep them all on the combined holding? Also how are we to organize them for effective working ?

It is generally accepted that men must be released from agriculture if the projected industrial development of the country is to be carried out. How far will this absorb part of the extra men? In the most highly industrialised nations with large markets for industrial products, but self-sufficient in food, the percentage of the population directly occupied in agriculture had been reduced to about 25 percent of the total population. Even with those conditions, social and economic organisation had not been worked out to employ fully the remaining population in industry, trade, services and transportation. There was before the war a large unemployment problem in all these countries. During the war, under the pressure of man-power shortages, the percentage of the population engaged in agriculture has been reduced in America to about 20 per cent and still sufficient food is produced. If we accept the higher figure of 25 per cent in agriculture on the assumption that the remainder can be absorbed in non-agricultural work, where do we come out ? That means that of every three now in agriculture, 2 would be released for other employment. On that basis, instead of 15-20 men on our combined farm, we would have 5 to 7. Still we have too many. How are they to be utilised ? Can a system be worked out through co-operative farming ?

There seem to be two conceptions of the "co-operative farm" idea, though neither of them seems to be very definitely worked out. One is that everything be pooled, all work together and divide the proceeds. The other advocates doing the "heavy" work with a tractor used on all the area, leaving the lighter work to be done with the bullocks, each man working on his own area and each enjoying his own production. Each of these plans involves serious difficulties. When examined closely the advantages do not seem large.

If we combine the whole area and the men into one unified unit, we have 5, 6 or 7 bosses and the necessity of deciding somehow on what is to be done, when, how and by whom. We have 5, 6, or 7 to do the work that can be done by one, with the possibility of doing some of the additional things which will make the place look better, some intensification of cultivation, and certainly the possibility of considerably increased leisure. We also have the problem of organisation by which the thing can be made to work smoothly. If each group contains a strong man, a leader whom all will follow docilely and who is unselfish and public spirited, doubtless the thing can be made to work. The assumption that each group will contain such a leader, that he be followed in the right spirit and that continuity of leadership of this type and quality can be maintained from generation to generation seems to me to be a decidedly risky assumption. The alternative seems to me to be bureaucratic control by which the leader would be appointed by outside authority and compliance be enforced by police authority or some other form of coercion. I do not see that this will either increase the production of crops or be in the interests of the development of human personality or individual freedom.

If we choose the other alternative of using a tractor for certain works, leaving the individual cultivators in charge of their individual areas to do the remainder of the work, we reduce the organisation difficulty by reducing the areas in which it has to function, but we do not eliminate it. We introduce uneconomic situations in that duplicate power must be maintained. The tractor would only be used at certain seasons but depreciation due to obsolesence as well as wear would have to be paid for the whole time or spread over the work done. The cost per unit of work done will be high. Similarly, the work animals will have to be maintained, though they would be utilised only part time. The larger the area in a tractor unit, and the more the tractor is used per year—and the less per farmer—the less this factor will operate till we reduce the use of the tractor by each farmer to the minimum. Advocates of this type of organisation, I believe, generally go on the assumption that there is sufficient work to keep the tractor busy a reasonable part of the year which cannot be done effectively by work animals, an unjustified assumption in my opinion and experience. They also assume, I think quite without justification, that the use of the tractor will increase yields. *It is not the type of power used but farm practices that determine yields.* To a large extent these are independent of the *kind* of power used, though they may to some extent depend on the *amount* of power available and they definitely depend to a very large extent on the kind of implements used.

My conclusion is that neither of these two types of co-operative farming will necessarily increase production, nor will either of them contribute to the development to the highest standard possible of human personality. I believe that both of these objectives, the increase of production and the development of human personality, the attainment of the largest possible measure of human happiness, will be furthered most by the continuance of the family farm, each unit, whether large or small, in the hands of and under the complete control of a family and worked, to the largest degree possible, by that family without outside interference or the necessity of outside help.

Are we then to forego all advantages of the use of mechanical power on Indian farms? Are we to give up all thought of co-operation as impracticable?

My answer would be *no to both questions*, definitely and without hesitation. The term "co-operation" is used with many different shades of meaning. I fully approve, of any form of co-operation which can be shown to be of sufficient advantage that people will enter into it voluntarily. If we can by experimentation work out any arrangement, which people will accept voluntarily, by which they will work together for mutual advantage, by all means let us do so. I believe that there are ways in which some types of power machinery can be used for the work of a number of individual farmers to advantage. I believe that such use of equipment is "co-operation" even though it does not involve an organisation and does result in private profit to an individual. There are jobs, mainly harvesting, threshing, cane-crushing, silo filling and similar work in which there is material advantage in using power driven machines and which any one farmer needs only for a few days at most in the year. I believe that it is desirable to experiment with the possibility of using them under the system known in America as "custom work" where the owner of a machine uses it in the service of another, for shorter or longer periods, and is paid according to results accomplished. This involves "organisation" only between two individuals at any one time and for any one piece of work. No permanent organisation is necessary. It makes possible the division of labour by which the idnividual who is skilled in handling machines and likes to work with them may give his full time to this, making a business of it. It makes available to the farmer the service of a machine without the necessity of his joining an organisation and giving up part or all of his individual liberty of action. He can use it or not as he thinks it profitable or not. While I believe that suitable machines can be most rapidly and most satisfactorily introduced under private ownership of the machines, I have no possible objection to a co-operative society which wishes to do so, owning and operating a machine or group of machines for the benefit of their own membership or as a service available to any one in the community. I think that the large society, able and willing to pay for skilled and experienced management and operation and willing to delegate authority, is more likely to successfully operate such machinery than is the small group, close to and likely to interfere with the operation of the equipment.

While at present it does not seem that the use of power-driven machinery for cultivation operations on the present small or prospective farms of India is likely to be generally feasible, I think that public agencies, the Agricultural Departments particularly, should continue to carry on experimentation on the possibility of adapting power units to these small farms. This should be a continuing programme, not simply a single trial over a short time, and should be related to other research in farm methods and practices. I believe that there is sufficient value in introducing improved types of animal-drawn implements to make it desirable to vigorously push a campaign for their introduction, even if they should prove to be only transition types. In my opinion, the production per unit area can be greatly increased, probably doubled, by better farm practices primarily dependent on better implements and without a change in social organisation and without the use of mechanical power. I also believe that as many men as can be absorbed into other occupations in the next two or three generations can be released from agriculture by the use of these animal-powered implements. Forcing by compulsion the introduction of other methods should not be undertaken till the th rough practicability and desirability of the new methods is fully demonstrated. "Starry-eyed reformers", to use the American term, can cause large-scale suffering without corresponding benefit by forcing too rapidly changes in social or economic organisation, even though the changes in themselves may be desirable. When the desirability of the change is open to serious question, it is doubly wise to be cautious in forcing changes.

WORK WITH WHITE RATS IN NUTRITION STUDIES IN THE HOME ECONOMICS DEPARTMENT OF THE AGRICULTURAL INSTITUTE

By

(Miss) Miriam E. Null.

The Home Economics Department of the Agricultural Institute received two pairs of white rats in October, 1945, from the Veterinary Research Institute at Mukteswar, U. P. Due to lack of available metal resulting from war conditions, there was great difficulty in securing cages for the new possessions. For a time converted bird cages and a rat trap had to be used. But bamboo bird cages were not practicable as the rats ate their way out to freedom. Enough cages never were secured and, consequently, as male and female could not always be kept separated, data on the females were not conclusive, as they became pregnant, sometimes gaining much more than under normal conditions and losing much at the birth of their young, Data on both male and female should be kept, as they differ in rate of growth, but they should be kept in separate cages until it is desirable to begin breeding. Therefore, although the females as well as the males were fed the various diets mentioned below, data on them are not included in this article. To be conclusive, experiments should be performed with a much larger number of rats and male and female should be separated.

The white rat is used in nutrition studies because its digestive system is similar to man's and it is omnivorous like man. It has been proved to respond to food much as man does, with the exception of vitamin C. The rat does not develop scurvy due to deficiency of this vitamin, whereas man does get this disease. The small size of the rat makes it possible to keep it in a small space, to feed it with little expenditure, and to dispose of its waste easily. Another reason it is often used in scientific work is because its short life cycle of only two or three years enables one to study effects of food on several generations. Experimental work with white rats is usually started after weaning when they are about twenty-eight days old and continued through the growing period of nine to ten weeks. Rats are fed once a day and weighed once a week.

The first study was for the purpose of demonstrating the effects of the ill-balanced and well balanced diets described in the government health bulletin, number 23, "The Nutritive Value of Indian Foods and the Planning of Satisfactory Diets." The ill balanced diet described, which is eaten by many people in India, consists of the following foods for a man per day :—

Rice	... 15 oz.
Milk	... 1 oz.
Pulses	... 1 oz.
Non-leafy vegetables	... 1.5 oz.
Green leafy vegetables	... 0.25 oz.
Fats and oils	... 0.5 oz.

The well balanced diet described consists of the following foods for a man per day :—

Rice	... 10 oz.
Millet	... 5 oz.
Pulses	... 3 oz.
Non-leafy vegetables	... 6 oz.
Green leafy vegetables	... 4 oz.
Fats and oils	... 2 oz.
Fruits	... 2 oz.
Milk	... 8 oz.

As the Agricultural Institute is in North India and *atta* or whole wheat was easily available, *atta* was fed instead of rice and millet. It will be noted that the well-balanced diet as compared to the ill-balanced one, contains the same amount of grain, eight times as much milk, three times as much pulse, four times as much non-leafy vegetable, sixteen times as much green leafy vegetable, four times as much fat, and in addition two ounces of fruit, the ill-balanced diet containing none of this latter food.

The rats were fed a total of about fifteen grams each per day, combining foods in this small amount in the same proportions as those indicated for a man for each diet. About 2% salt (NaCl) was added to their food and, of course, they were given all the water they wanted. An effort was always made to give them enough food, so that a little remained each day. Thus results were due to quality rather than to quantity of food.

At the same time the ill-balanced and well-balanced diets were compared, other rats were fed the Columbia University stock diet consisting of three parts whole wheat flour (*atta*), one part powdered whole milk, and 2% salt (NaCl). In addition they were fed about all the green leafy vegetables they would eat. These rats were six days younger than those on the well-balanced and ill-balanced diets which were the same age. Due to the impossibility of getting cages, those on the green leaf—Columbia University stock diet were not started on the experiment until over two weeks after the others.

The results were as follows for the males :—

Description of Diet.	Weight in grams at beginning	Weight in grams February 21	Total gain in grams.
Atta 3 parts, powdered whole milk 1 part. As much green leafy vegetable as they would eat.	Jan. 1. 50.6	189.3	138.7
Well-balanced diet	Dec. 17. 24	129.4	105.4
Ill-balanced diet	Dec. 17. 25.5	88.7	63.2

The female on the ill-balanced diet ate most of her young, whereas the others did not. This may or may not have been significant.

Thus, it is apparent those fed the *atta*, powdered milk, and green leafy vegetable gained much more than the others, although they were younger and were not started on the diet until more than two weeks after the others. The male on this diet made a total gain of 33.3 grams more than the rat on the well-balanced diet, whereas the latter on Feb. 21, had made a total gain in weight of 42.2 grams more than the rat on the ill-balanced diet. The well-balanced diet in Bulletin 23 is planned for an adult, and although it contains eight times as much milk as the ill-balanced diet, it still does not contain the optimum amount for a growing child. A rat twenty-eight days old is comparable to a young child. Therefore, those rats which had much more milk and green leafy vegetable, flourished the best. The rats which had been on the ill-balanced diet, on February 26 were given daily the *atta*—powdered milk—leafy vegetable diet. The male gained from 88.7 grams on February 21 to 177 grams on March 30, just doubling his weight.

A second experiment was begun on March 30 comparing the following four diets :—

1. *Atta* plus as much green leafy vegetable as rats would eat.
2. *Atta*, 3 parts; *besan* (Bengal gram) 1 part.
3. *Atta*, 7 parts ; powdered whole milk, 1 part.
4. *Atta*, 3 parts ; powdered whole milk, 1 part.

The results were as follows for the males :

Description of Diet.	Weight in grams at beginning March 23.	Weight in grams April 27	Total gain in grams
Atta and green leafy vegetables ..	55.1	140 2	85.1
Atta and *besan* (Bengal gram) .	64.0	132.0	68.0
Atta 7 parts ; powdered milk 1 part	73.2	164.9	91.7
Atta 3 parts ; powdered milk 1 pat	46.0	143.3	97 3

There was only two or three days difference in the ages of the rats, but all except one were too large to begin with. A rat for experimental purposes should not weigh more than 50 grams at the start of the experiment. The experiment is not conclusive as it should have continued for about six weeks longer, and like the other, more rats should have been fed each diet, and the males separated from the females. However, the results for such a short time are suggestive. Again the one getting the most milk made the greatest gain, and that getting less milk did the next best. The one which ate only *atta* and green leafy vegetables did very well. At the last he ate about thirteen grams of lettuce or cabbage per day. The rat fed the *atta* and Bengal gram gained the least. It would have been interesting to have tried other rats on *atta* alone and others with still smaller amounts of milk with *atta*.

Both experiments emphasize the importance of milk and green leafy vegetable in our diet.

(*Continued from page* 67)

drying the nut is separated from the husk and again put out in the sun to dry for three more days. When the nuts are thoroughly dried they are sacked and sold.

(*ii*) Instead of splitting the fruits they are dried in heaps. This method requires very little labour but it takes about three months to dry the fruit sufficiently to enable the husk to be separated from the nut. When the husk has been separated the nut is again dried in the sun for two or three days before it is ready.

The nuts are received in the market principally in two different forms : whole and split.

(*Continued from page* 61)

we think in terms of an All-India Christian Agricultural College with many extension work in Christian fields. Such an institution, may well be under an organization like the N. C. C. and the extension fields under a provincial Board like the U. P. Christian Higher Education. "Co-operation between Christian Agricultural College and Chriatian settlements is essential. As Dr. Sam Higginbottom said often " It makes two to co-operate"; but let us not be complacent and await for the other person to extend his hands first.

SEASONAL DISTRIBUTION OF SUGARCANE BORERS IN BIHAR.

By

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The sugar industry has come to the front rank amongst Indian industries, and, consequently, much research work has been done recently on sugarcane borers and on methods of their control. Side by side, with laboratory studies, intensive and extensive field observations under different climatic conditions were started in different parts of India. In the present article only a brief narrative on the distribution of borers in the crop under different climatic conditions in Bihar is given The sugarcane crop has three types of borers attacking the plants, namely, top-shoot borers, stem borers and root borers. All these are lepidopterous insects but belong to different families, genera and species. The most common ones met with in Bihar are the following :—

Scirpophaga nivella F. (a top borer), *Argyria stictierospis H.* and *Diatroea auricilia* Dud (stem borers), and *Ennalocera depressella* Swin (a root borer).

TOP BORERS

Scirpophaga nivella F.—This borer is found in the field throughout the growing season of the crop. As the name suggests the insect attacks the top portion of the cane. The caterpillar, which is the larva of a moth, bores into the stem of the cane plant from the top shoot and damages the growing point. Thus it causes mortality in young shoots or retards the growth of grown up ones. Plants attacked by this borer are easily detected by the peculiar bunchy side shoots given off from the attacked central top shoots and a characteristic "dead heart" produced.

Life history and habit.—Pale yellow eggs are laid in clusters on the surface of the leaves and are covered with a yellow tuft of hairs. The larvae hatch out from these eggs and find their way to the mid-rib of the cane leaves, bite a hole and enter it. Here they feed for a couple of days and then enter the cane stem from the top and complete their life cycle. The larva is quite different in appearance from the rest of the borers. It has a yellowish cream white colour. The moth is easily distinguished by its uniform white colour, with a crimson hairy anal tuft on the female.

The insect is found in the field from early May, but its population r mains quite low during the summer months when the temperature is high and the humidity low. With the advent of the monsoon, when the humidity is on the increase and the temperature continues to be high, the population increases but does not reach the maximum until the autumn months when the humidity remains fairly high and the temperature lower.

STEM BORERS

Argyria stictierospis H and *Diatroea auricilia* Dud.—There are two species of stem borers that are found to damage the cane in all the important cane areas of Bihar, namely, *Argyria stictierospis H* and *Diatroea auricilia* Dud. These are pale straw coloured pyralid moths, the caterpillars of which bore into the growing stem of the cane and often cause serious damage. The more important one appears to be *A. stictierospis H.* Both the very young plants and the growing canes are affected but the damage to the former is far more serious since the infested shoot is killed. The presence of "dead hearts" with a characteristic odour at the base of it in a young cane field is a sure sign of the presence of this pest. The other borer, *D. auricilia* Dud is one which is usually found to attack grown up canes causing comparatively much less damage.

The life histories of both the borers are similar. Pale, scalelike, oval, and overlapping eggs are laid in clusters on the surface of the leaves. The larvae hatch out, feed for a few hours on the leaves, then find their way to nodal portions of the cane, bite a hole through the stem and enter it. Here they grow, feeding on the inner content, and undergo pupation, and then come out as straw coloured moths The larvae are white in colour with brownish stripes on the body. The distinguishing character of the larvae of the two species is that in the former the spiracles are incomplete and in the latter complete. Similarly, in case of the two moths, the colour of the latter (*D. auricilia* Dud) is darker than that of the former (*A. stictierospis H.*)

A. stictierospis H. is found in the field from the second fortnight of May and begins to increase rapidly. It remains quite high during summer months when the humidity is low and the temperature fairly high. With rise in the humidity and fall in the temperature during the monsoon period, its population starts decreasing and almost completely disappears from the field during winter months.

D. auricilia Dud is just the reverse from the previous one. During summer months, *i. e.*, in low humidity and high temperature, this pest is not found in the field. With the outbreak of monsoon, when the humidity is on the increase and the temperature lower, this pest starts appearing in the field, but is found to be in maximum number during winter months when the humidity is fairly high and the temperature comparatively low.

ROOT BORERS

Emmalocera depressella Swin, the root borer, is found to damage the crop in the field from its germination till harvest. It remains below the soil and damages the root portion only. In the young cane it has been the cause of "dead hearts" resulting in the mortality of the cane. Its dead heart is similar to that of stem borers, the only difference being that it cannot be pulled out easily nor does it have any odour. In grown-up canes its damage is not serious.

The moth is pale straw colour but much bigger in size than the ones mentioned above. It lays creamy white oval eggs, and these eggs are not in cluster but are laid separately, only one or two being on each leaf. The larva hatches out of the egg and comes down to the soil, makes a hole in the root zone of the cane and completes its life cycle inside it. The larva is white in colour and is much larger in size than the larvae of the above mentioned borers.

This insect is found in the field from the time of germination of cane shoots until the harvest. Its population is quite high during summer months but it reaches the peak during the monsoon period when the humidity is high and temperature moderate. During the winter months its population goes down considerably.

CONCLUSIONS

Although the different borers mentioned above are found to be present in the field from the germination of canes till harvest, the intensity of their population is found to differ during different seasons of the year.

From what has been said above, we can conclude that

1. High or moderate humidity with low temperature encourages the top borer, *S. nivella F.*
2. Low humidity with high temperature encourages the stem borer, *A. stictierospis H.*
3. High humidity with low temperature encourages the stem borer, *D. auricilia* Dud.
4. High humidity with moderate temperature encourages the root borer, *E. depressella* Swin.

The above conclusions are based on the four years of field observations of the writer.

List of wild plants found in the Upper Gangetic plain and the adjecent Siwalik and Sub-Himalayan Tracts, whose fruits of some other portinos are edible †II.

By M. A. A. Ansari.

Botanical Name.	Vernacular Name.	Family.	Locality.	Remarks.
1. Berberis asiatica	Kingora ..	Berberideae ..	Dehra Dun, outer Himalaya from Garhwal to Bhutan.	The berries are eaten.
2. Flacourtia sepiaria ..	Kondai ..	Bixineae ..	Dehra Dun, Kumaon	The fruit is eaten.
3. Hibiscus micranthus .	..	Malvaceae ..	Common in the drier parts of the area.*	Roxburgh says that the green capsules are eaten by children.
4. Sterculia urens ..	Kuli, Kulu kor ..	Sterculiaceae .	Tarai and Sewalik tracts westwards to the Jumna; also in Bundelkhand, and Gwalior mostly on dry rocks.	The seeds are sometimes eaten roasted.
5. Sterculia pallens ..	Kordala ..	,, ..	Dehra Dun and Siwalik range. Himalaya upto 5000' in Garhwal and Kumaon.	The seeds are eaten.
6. Grewia tiliaefolia ..	..	Tiliaceae ..	Dehra Dun, Pilibhit, N. Oudh, Merwara but not common. Probably in the Siwalik range and Bundelkhand.	The fruit is eaten.
7. Grewia excelsa ..	..	,, ..	Bundelkhand..	The fruit is eaten.
8. Grewia seabrophylla	Pharsia, garbheli..	,, ..	Sub-montane tracts from Dehra Dun and the Saharanpur district to Pilibhit in N. Oudh.	The fruit is eaten.
9. Grewia Salvifolia ..	,, ..	,, ..	Oudh forests and in Merwara.	The sub-acid fruit is eaten.
10. Grewia polygama ..	..	,, ..	Dehra Dun, Siwalik range, Rohilkhand, Oudh, Bundelkhand.	The fruit is eaten.

† The first part of this article appeared in the January-March (1946) issue of the Allahabad Farmer.

* Area means the upper Gangetic plains and the adjacent Siwalik and Sub-Himalayan tracts.

A List of wild plants.—(*contd.*)

Botanical Name.	Vernacular Name	Family.	Locality.	Remarks.
11. Averrhoa Bilimbi ..	Bilimbi ..	Geramiaceae ..	In gardens throughout hotter parts of India.	The very acid fruit when ripe in the rainy season is often used in curries.
12. Impatiens Balsamina	..	,, ..	In Dehra Dun and the other parts of the upper Gangetic plains.	The seed of this and other species are eaten and the oil which they contain is used as food.
13. Glycosmis pentaphylla	Ban nimbu ..	Rutaceae ..	Common in many parts of the area* especially in Dehra Dun.	The fruits are eaten.
14. Murraya Koenigii ..	Gandhela, Kathnim, Harri (Oudh), Gundi (Bijnor).	,, ..	Abundant and often gregarious in the northern portion of the area*	The leaves are much used to flavour curries.
15. Feronia elephantum ..	Bilin, Katbel (Elephant or wood apple.)	,, ..	Siwalik range and the forests at the base of the Himalaya in Rohilkhand and N. Oudh often cultivated.	The pulp of the fruit is used as a food adjunct.
16. Aegle Marmelos ..	Bel, Bil, (Bael tree)	,, ..	Common in the Dehra Dun and the Saharanpur forests and in the other parts of the area* but often cultivated.	The pulp of the ripe fruits is eaten as food.
17. Zizyphus Jujuba ..	Berberi (Indian, Jujube).	Rhamneae ..	Common and gregarious along the bases of Saharanpur Siwalik, also in Dehra Dun in other parts of the area*. Throughout India.	The fruits are largely eaten by the people and are much valued in time of scarcity.
18. Vitis latifolia ..	Pani bel musal ..	Ampelideae ..	Dehra Dun and the Siwalik range chiefly in Sal forests also in Rohilkhand, Oudh, Merwara and Gwalior.	The berries are eaten.
19. Indigofera linifolia	Torki ..	Leguminosae	Common throughout the area* especially amongst grass throughout the hotter parts of India to Ceylon.	The seeds of this plant are largely collected in famine times by the poorer classes and eaten in the form of bread.
20. Ericsema chinense ..	..	,,	Saugor, Western Himalaya from Garhwal eastward to Khassia and Assam.	The tuberous roots are sometimes eaten.
21. Indigofera condifolia	Vekriavas (Rajputana)	,,	Fairly common within the area* especially on sandy grounds. W. Himalaya up to 4000'.	The flour prepared from the seeds is largely used in Rajputana as a famine food.
22. Bauhinia Vahlii ..	Maljhan, Malu ..	,,	Dehra Dun and Saharanpur forests. Rohilkhand, N. Oudh, Bundelkhand, outer Himalaya from Chenab to Assam.	The seeds are eaten as food after being roasted.
23. Prosopis spicigera .	Jhand, chaunkra ..	,,	Not un-common in the drier parts of the area* as in Merwara, Bundelkhand, Delhi and Agra.	The sweetish pulp inside the young pods of this tree are largely used as food. The bark which has a sweetish taste is also consumed in the form of flour in famine times.
24. Acacia concinna ..	Ailah, rassaul ..	,,	Dehra Dun (rare); abundant in the Kheri and Bahraich forests, in N. Oudh, W. Himalayas in Jaunsar.	The acid leaves are made into chutney.
25. Albizzia procera ..	Safed siris, karhs, dun siris.	,,	Forests of Dehra Dun and Saharanpur and in the sub-Himalayan districts of Rohilkhand and N. Oudh and Gorakhpur usually in the moist localities.	The bark is used in times of scarcity. It is ground up with flour and eaten.
26. Terminalia belerica ..	Behera ..	Combretaceae	A common forest tree within the area* also much planted. Distribution, plains and lower hills throughout India.	The kernels of the fruit are largely eaten by the people.
27. Terminalia chebula	Har, harark ..	,,	Forest of Dehra Dun and Saharanpur, Rohilkhand, N. Oudh, Bundelkhand, outer Himalaya up to 5000',	The kernel is eaten.
28. Eugenia Heyneana ..	..	Myrtaceae ..	Bundelkhand; Saugor, usually found on river banks, Chhota Nagpur and Central and Western India.	The fruit is eaten.
29. Coccinia indica ..	Kanduri ..	Cucurbitaceae	Common within the area.* Throughout India and Ceylon.	The young green fruit is used in curries and when ripe is eaten raw.

* Area means the upper Gangetic plains and the adjacent Siwalik and the Sub-Himalayan tracts.

A List of wild plants.—(*contd.*)

	Botanical Name.	Vernacular Name.	Family.	Locality.	Remarks.
30	Randia uliginosa ..	Pindalu, pindar, pandara, panar, pirar, mainphal.	Rubiaceae ..	Saharanpur and Pathri forests, Siwalik Range, Dehra Dun (rare), Sub-Himalayan tracts of Pilibhit and N. Oudh, Bundelkhand.	The fruit is eaten.
31.	Bassia butyracea ..	Cheuli, chiura ..	Sapotaceae ..	Dehra Dun at Tapoban and occasionally as a small tree in Gonda District and N. Oudh, Sub-Tropical Himalaya up to 5000'.	The pulp of the fruit and the oil cake are eaten.
32.	Mimusops hexandra	Khirni ..	,,	Forests in Kheri District, in N. Oudh,, apparently wild. Also in Bundelkhand.	The fruit is eaten.
33.	Diospyros tomentosa	Tendu, mitha tendu, abnus.	Ebenaceae ..	Siwalik range, chiefiy on the southern slopes towards the Jumna. Sub-Himalayan tracts of Rohilkhand, N. Oudh and Gorakhpur, also in Bundelkhand and Merwara.	The fruit contains a sweetish astringent pulp which is much eaten by the people.
34.	Salvadora oleoides ..	Jhal, jal ..	Salvadoraceae	Confined to the dry and usually saline tracts of the western portion of the area*. Often found growing in company with S. Persica from which it can be distinguished by its more sombre green foliage.	The sweet fruit is eaten specially in times of scarcity.
35.	Carissa carandas ..	Karaunda ..	Apocynaceae ..	Wild in the Bahraich and Gonda forests of N. Oudh and in the Gorakhpur district, but cultivated in many places within the area.*	The ripe fruit is eaten.
36.	Periploca aphylla .	..	Asclepiadaceae	Merwara and lower slopes of the outer Himalaya.	The fragrant flowers are eaten.
37.	Pentatropis cynanchoides	..	,, ..	In the dry western and south-western portions of the area* abundant in the Jumna and Chambal ravines.	Stewart mentions that the sweet tubers are often eaten.

38.	Cordia Rothii ..	Gondi, Gondni ..	Boraginaceae ..	Found wild in the Merwara and Bundelkhand districts.	The pulp of the fruit is eaten.
39.	Solanum Xanthocarpum	Kateli ..	Solanacea ..	Abundant within the area* by the road side and on waste grounds. Throughout India and up to 7000' in the Himalaya.	The fruits are said to be sometimes eaten.
40.	Amarantus viridis ..	..	Amarantaceae	Common weed in cultivated ground. Throughout India	The tender tops are eaten.
41.	Elaeagnus latifolia ..	Chiwai ..	Elaeagnaceae ..	Dehra Dun, usually in swampy ground. Also in the Sub-Himalayan tracts eastwards.	The sub-acid astringent fruit is much eaten by the people.
42.	Bridelia retusa ..	Kaja, Lamkana, goya.	Euphorbiaceae	Siwalik range, forest of Dehra Dun and Saharanpur, often also associated with Sal. Plentiful in Himalayan tracts of Rohilkhand and N. Oudh, also in Bundelkhand and Gorakhpur.	The sweetish fruit is eaten.
43.	Celtis australis ..	Kharak, Kharak-chaena, nettle tree	Urticaceae ..	Dehra Dun, both planted and self sown Probably wild in the forests of N. Oudh and in the Bijnore forests of Rohilkhand	The sweet fruit is sometimes eaten.
44.	Debregeasia velutina ..	Tushiari siaru ..	,, ..	Dehra Dun eastwards along the sub-Himalayan tract sub-tropical Himalaya up to 5000' from Garhwal to Sikkim.	The orange coloured ripe fruit resembles a small roseberry and is eaten.
45.	Debregeasia hypoeluca ..	Sansaru ..	,, ..	Dehra Dun and Siwalik range in the Bijnore district, Sub-tropical and temperate Himalaya from the Sarda river in Kumaon, westward to the Indus up to 6000' in Himalaya.	The fruit becomes yellow when ripe and is eaten.
46.	Streblus asper ..	Siora, dahia, kuchna, rusa.	,, ..	Common along the river banks and in hedges near the villages especially in Bundelkhand and in the Sub-Himalayan tract of Rohilkhand and N. Oudh.	The fruit is eaten.

*Area means the Upper Gangetic plain and the adjacent Siwalik and Sub-Himalayan Tracts.

A List of wild plants.—(*contd.*)

Botanical Name.	Vernacular Name.	Family.	Locality.	Remarks.
47. Ficus Rumphii ..	Khabar, gajiun, pilkhan, ganiper, paras pipal.	Urticaceae ..	Forests of Dehra Dun, Saharanpur and eastwards along the sub-Himalayan forest tracts of Rohilkhand, N. Oudh, and Gorakhpur, also in Bundelkhand and Merwara.	The fruit is eaten.
48. Curculigo orchioides ..	Musali kand, mushali.	Amaryllidaceae	Abundant in the sub-Himalayan tracts of Pilibhit and N. Oudh and also in Merwara. Outer Himalayan ranges from Kumaon eastwards. Khassia hills, Manipur, south to Bengal.	The black root, a kind of musali, is ground and eaten like flour at Balrampur, N. Oudh.
49. Dioscorea belophylla Section Enautiophyllum.	Tur hur, toree ..	Dioscoreaceae..	It is common within the area of this flora specially Dehra Dun and the Siwalik range, also in N. Oudh, Bundelkhand and Mirzapur District.	The tubers are much eaten.
50. Asparagus racemosa ..	Satmuli, Satrawal, Chatawal, Sahasmur, wild asparagus.	Liliaceae ..	Very common within the area of this flora. Throughout tropical and sub-tropical India up to 4000' on the Himalaya.	The white tuberous roots of this plant are collected for food and constitute a kind of white musali.
51. Smilax macrophylla ..	Ramdatun ..	,, ..	Sub-Himalayan tract from Dehra Dun eastward to Rohilkhand and N. Oudh and Gorakhpur and also in Sal forests on the Siwalik range from Kumaon to Assam.	The root of this plant is powdered and the flour is made into bread at Balrampur in N. Oudh.
52. Asphodelus tenuifolius	Bokat piazi ..	,, ..	Abundant within the area* as a weed of cultivation and often becoming a pest.	The plant and seeds are sometimes eaten in India by famine striken people.

*Area means the upper Gangetic plains and the adjacent Siwalik and Sub-Himalayan tracts.

WAYS OF INCREASING PROFITS ON THE FARM

(Contributed)

In commercial farming the chief aim in the proper management of the farm is to make profits. Every person who takes up farming as his business has an eye on profits. The greater profits he makes on the amount of money invested, the greater satisfaction he gets from his business. Even before one decides to buy land for farming he first considers the possible profits or loss which may accrue from that piece of land.

Before going any further, however, let us first try to understand as to what is meant by profits in farm business.

The difference between the value of the milk and the value of the feed of dairy cows is not profit, because the feed is usually only about half the cost. Neither is a difference between the cost of a fertilizer and the value of increased crop a profit from the treatment. In this case also the cost of fertilizer is only about half the cost.

What should be our unit in measuring profit? Is it to be measured per acre or per farmer? All these questions have to be considered when one wants to measure profits. Profit, as is meant here, is the amount of money made after all expenses of every kind have been subtracted. Profit depends on many factors. It depends, for instance, on the cost of machinery, interest rates, management of live-stock, quality of live-stock, roads and distance to markets, ease of working fields, natural fertility and fertilizer, quantity of seed, continuity of employment, and wages. It also depends on factors that are not under the control of the farmer, like sunshine, temperature, prices of products, and rainfall. Besides these, other factors like drainage, cultural methods, and quality of seed, also help to increase or decrease farm profits.

The first recommendation that can be made regarding ways of increasing profits is by proper adjustment of all the factors of production. In other words, there should be a uniformity in attention to all limiting factors. Anything, like an improper adjustment of the different factors of production of a farm enterprise is a waste and should be curtailed by proper adjustment. For instance, a farmer who goes out to try to produce forty-five maunds of wheat per acre would not make as much profit as the one who produces only twenty-five maunds per acre; for the simple reason that it would require a great deal of labour and care in the preparation of the soil, in the selection of the seed, and in the nurture of the plants, to be able to produce up to 45 maunds of wheat per acre. In short, it would be a great waste of time and energy, because there is a limit to the quantity which can be produced within a given area. So an increase in one line, say, labourers for instance, must be accompanied by an increase in the capital or an improvement in the quality of the tools and machinery, or an improvement in the methods of farming.

The next important consideration is the economizing of labour in order to increase profits. At present this problem is not so pressing. But with the advance made in industries the labour wages will go up so that any lack of control in this direction will result in a great deal of expense, and thus reduce the amount of profits to be obtained from the enterprise. The main purpose in any rational industrial management is to secure as large a product per man as possible, and not necessarily as large a product per acre as possible as we have indicated above. So cheap labour is by no means the way out, in curtailing waste in this direction. A large supply of cheap labour means the support of a large number of families on very low wages. In order to increase

the amount produced per man, we must have recourse to several steps. First, the productivity of the land has to be increased. So a careful consideration should be given to the cultivation of the land, the rotation of crops, and the application of fertilizers. In this connection it must be reminded that the Law of Diminishing Returns must not be lost sight of. A farmer cannot double his crop on a certain piece of land by doubling the amount of work on that land. But at the same time a niggardly application of labour and capital in the cultivation of any crop is of very little value.

Another item that needs consideration is the equipment of the farm business. Unless the farmer watches this carefully a great amount of his profit will be wasted in this. In this as in all other cases, the "law of proportion" holds true, namely : the different forms of capital must be combined in the best proportions. Or when stated concretely, it means that there should not be too few or too many bullocks for a certain size of the farm ; or the buildings should not be too big for a certain size of business and neither too small, or too shaky. It is not profitable to buy a tractor for a small-sized farm. There are a great multitude of farm operations which cannot be performed efficiently or economically except with animal power. Again, one has to find out what kinds of animals are to be chosen ; for instance, between a buffalo and a bullock, or between bullocks of different breeds.

Another way of increasing profit is by curtailing waste caused by rats and similar macro-organisms present in the soil, and by other predatory animals like monkeys, wild pigs, jackals and *nilgais*. The methods to get rid of these pests are, of course, different with different animals. Any progressive farmer should be acquainted with the best methods of controlling any of these pests.

Another form of waste may be caused by insect pests. Some of the methods for the control of insects are (1) crop rotation, (2) time of planting the crop, (3) the control of weeds which afford food for insects, and places for their hibernation ; (4 method of fertilization and culture, (liberal fertilization and culture, for instance, helps the plant to withstand the insect attack), (5) clean farming ; (6) deep plowing and thorough harrowing ; (7) Planting trap crops ; (8) the use of "light" traps and (9) the use of mechanical means for the collection of insects.

Another form of waste which is closely related to this one is caused by plant diseases. The most common of plant diseases are generally caused by fungi. But this is also a subject by itself. So we can only suggest a few of the methods used to control such diseases. First, proper regard should be had for such factors as varietal resistance, seed selection, crop rotation, seed treatment, application of fungicides to the growing crop, and general sanitation.

Another method of increasing profit is by the control of weeds. Weeds steal a great deal of plant food, and should, therefore, be destroyed or controlled.

Still another form of waste may consist in the waste of energy of the workers. The distance of the farm buildings from the farm should be properly adjusted so that the workers do not have to take more steps than what would be necessary. This means that the location of farm buildings should be carefully considered when laying out the farm and the farmstead.

Feeding farm animals is another item in farm management that has to be considered. Here also, a wise use of economy will enable the farmer to increase his profits. But economy should not mean frugality. If the work-stock are underfed, they will not be able to do the work which they would otherwise. It is, therefore, essential for a progressive farmer to get acquainted with the prin-

ciples of feeding livestock on the farm. Wolff-Lehmann standards for feeding horses are given below :—

Nature of work	Dry Matter	Digestible Nutrients			Nutritive ratio
		Protein	Carbohydrate	Fat	
1. Lightly worked ..	20	1.5	19.5	0.4	1 : 7.0
2. Moderately worked ..	21	1.7	11.0	0·6	1 : 6.2
3. Heavily worked ..	23	2.5	13.3	0.8	1 : 6.0

"In making up a feeding ration for a bullock the first point is to find out how much the bullock will eat ; the next is to regulate the ration according to the demand to be made upon the animal whether the work is heavy or light, regular or irregular ; then consider the feeding stuffs that are available, and finally the season and the weather."

Besides the Wolff-Lehmann standards of feeding farm animals, we have other standards which should be studied, like the Armby's standard, especially by those whose special industry is the raising of animals. These methods of feeding will help the farmer to obtain his required results, which will materially decrease the waste in feeding and thereby increase his profits.

There are still a number of ways of increasing profits by curtailing wastes, but all of them cannot be discussed here. The last one that may be mentioned here, however, is that every farmer who expects his business to pay well, must keep correct accounts of all the different items in the farm business. This is also the best method to detect waste, and helps the farmer to understand his business well.

Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India)

THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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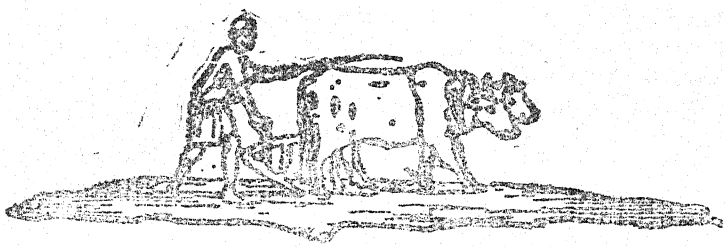

VOL. XX] JULY, 1946 [No. 4

Editorial

This is the "Report Number" of the Allahabad Farmer in which each Department of the Allahabad Agricultural Institute reports on its activities during the past year.

We take pleasure in announcing the establishment of a new Department—that of Extension Service—in the Agricultural Institute.

In this number of the Allahabad Farmer you will find no report of that Department because it has just begun to function due to the fact that its head, Dr. A. T. Mosher, had been loaned to serve in connection with the Committee on War Surplus Supplies in Calcutta. Dr. and Mrs. Mosher only returned from furlough about the middle of March, 1946, and from early in May until well on into the month of September, 1946, Dr. Mosher has given of his best efforts in full time service to this cause. War Surplus materials from trucks, jeeps, garden tools, stationery, drugs and chemicals, laboratory appliances, etc., to clothing, refrigerators, etc., have been distributed far and wide over the map of India. And considering the innumerable complexities of this task the consensus of opinion is that the job has been well done. It is only within very recent weeks that Dr. and Mrs. Mosher have actually settled in Allahabad and the work of this new Department of Extension Service has actually begun to get under way, although during the months of March and April Dr. Mosher had done some preliminary spade work in connection with it. Next year there will be a report of this Department of Extension Service included amongst other reports in the Annual Report issue of the Allahabad Farmer.

In addition to the changes which will be seen in connection with the work of the several Departments, it should be noted that the Department of Agronomy is without the services of its head, Mr. B. M. Pugh, who was given sabbatical leave by the Board of Directors from July 1, 1946. He had intended to spend the year in certain research work in connection with the Imperial Council of Agricultural Research, New Delhi, but the Government of Assam was insistant that he accept an appointment in his home province as special agricultural officer in connection with the development of agriculture in the far North Eastern Hills of Assam. The Board of Directors on the recommendation of the Institute Council has given permission to Mr. Pugh to accept this post on special leave and recent letters from him indicate that he is having rich and unusual experiences in studying the agricultural problems of the hills and valleys of that far

distant area of India. Names of places which became well known during the war are now quoted by him in some of the interesting accounts which he sends.

Dr. and Mrs. Millen left for furlough in early July, 1946 and Miss M. E. Null of China, on special loan to the Department of Home Economics, accompanied them to the U. S. A. for special health treatment.

As one goes through the several reports of the Departments one will observe that numerous changes in the staff have taken place. Not only so but the Institute has grown considerably in that the new Inter Sc. Ag. class has had a second section admitted so that it now is double its size of former years. The new I. D. D. class was also the largest ever admitted, and there are more young women in the Department of Home Economics (23 at this writing) than have ever been admitted before. It will thus be seen that the general programme of expansion in connection with the Agricultural Institute is definitely under way.

To make this possible, the second floor of the formerly constructed middle portion of the men's new hostel, work on which had to be suspended with the completion of the first floor early in the war, has now been constructed. Further extension of this building in accordance with plans adopted has already been undertaken. Two new residences are near completion, one of which is an apartment building with three complete suites. It is fully expected that within the course of the next year work on the new Library—Administration building will be undertaken.

The Institute thus is growing both as to student capacity, teaching staff and the addition of a new department. The teaching staff at this writing, however, is limited in number due to the fact that the Koshys of the Department of Biology and Home Economics, and the Warners of the Department of Animal Husbandry and Dairying and Home Economics, are not yet back in India from their stay in the U. S. A. It is a pleasure to report that a new family for the Department of Animal Husbandry and Dairying is also to come soon. Dr. A. J. McClurkin, Veterinarian, is to join the Department of Animal Husbandry and Dairying, and Mrs. McClurkin, holding a B. Sc in Home Economics, will add strength to the Home Economics Department of the Institute. In spite of many changes the Institute is carrying on and will continue to do so in the spirit of service to India.

—Dr. J. L. Goheen, Principal.

The Allahabad Agricultural Institute is primarily an educational institution, one of whose aims is to teach an Indian young man how to get a living by farming.

—Sam Higginbottom.

REPORT OF THE AGRONOMY DEPARTMENT, 1945-46.

By

B. M. Pugh, G. D. Singh and S. R. Misra.

Staff (B. M. P.)

The relationship with the University continued to keep Mr. Pugh part time for teaching Genetics and Plant Breeding. Mr. S. R. Barooah went on leave in July to proceed to America to study for a Ph. D. at the University of California, Mr. A. K. Dhar coming in to take over part of the teaching. Mr. H. G. Gupta left the Department in March, 1945, Mr. G. D. Singh taking over the work of Mr. Gupta.

Research and Experimentation (G. D. S.).

The department continued its programme of research and experimentation which had been reported in previous years, the main objective in this being the selection or evolution of varieties of crops most suitable for this locality.

Sugarcane :—The work on sugarcane was started in 1942 in co-operation with the United Provinces Department of Agriculture. Nine varieties, namely, Co. 313, Co. 331, Co. 312, Co. 393, Co. 421, Co. 527, Co. 146, Co. 5 and Co. 76 were selected on the basis of their performances elsewhere in the Province and included in the original experiment. As a result of the experiment in 1942-43, Co. 146 and Co. 5 were dropped. Their performance was much below the others. In February, 1944, Co. 331, Co. 312, Co. 313 and Co. 421 were selected out of the remaining seven to test in a randomized block experiment. In 1944-45, variety Co. 421 was dropped because it was susceptible to red rot, and replaced by Co. 453.

The sugarcane varietal experiment in 1945-46 consisted of Co. 331, Co. 312, Co. 313, Co. 393, Co. 527 and Co. 453 in a randomized block layout of six replications. The size of each plot being 21′ × 87′ and the size of each block being 126′ × 87′. The experimental plot size, after removal of all non-experimental rows, being 15′ × 81′. The total sugarcane yields of the varieties in seers were as follows :—

Co. 453	Co. 33	Co. 393	Co. 313	Co. 312	Co. 527
3496·0	3254·5	2906·5	2688·5	1097·5	1539·0

The total yield of *Gur* of these six varieties were, in seers, as follows :—

Co. 453	Co. 393	Co. 331	Co. 313	Co. 527	Co. 312	Sig. Diff.
319·0	297·0	293·0	268·0	175·5	156·5	85·28

The lines underneath the yields of *gur* indicate the group in which there was no significant difference when the results were analysed statistically. These results as well as the three years' observations of the experiment would seem to show that Co. 313 should be preferred to the others as a field cane for the average cultivation. Co. 331, Co. 313 and Co. 421 stood up equally well in the matter of lodging whereas Co. 312 lodged badly. Co. 313 was the most drouth resistant and also displayed some resistance to red rot. Co. 312 and Co. 421 were very susceptible to red rot.

In February, 1946 Co. 453 and Co 393 were selected for a randomized block experiment. This is a varietal as well as an agronomical experiment of which the data will be available in the next departmental report.

Paddy :—A duplicate randomized block experiment was laid out in which eight varieties of rice were tested. These were Basmati, Jarwar, Lijura, Badsha, Type 1, Number 17, Bansi and Jhalore. Of these Basmati, Jarwar, Lijura, Type 1, No. 17, Bansi and Jhalore were selected out of the 1944-45 experiment; Badsha was dropped because of its poor performance, and it was replaced by a local

paddy Ramkajra. The plot size was 9′×60′ and there were six replications. The ultimate plot size after removing border rows from each plot and two feet from each end was 7′×56′. The total grain yield of broadcasted experiment of each variety, in seers, were as follows :—

No. 17.	Jhalore.	Lijura.	Jarwar.	T. 1.	Basmati.	Bansi.	Ramkajra.
44·5	40·0	38·5	34·5	31	28	27·5	27

Significant difference
6·58

Yield of bhusa in seers :—

No. 17.	Jhalore.	Ramkajra.	Bansi.	Jarwar.	T. 1.	Basmati.	Lijura.	Sig. Diff.
109	100·5	96	95	92	82·5	81	71·5	21·64

Yield of grain of each variety in seers in the transplanted experiment :—

Jarwar.	No. 17 and Jhalore.	Lijura.	Bansi.	Basmati.	Type 1.	Ramkajra.
36	35·5	32·5	35·0	26·0	24·0	6·0

These results confirm the conclusions arrived at the previous year, namely, that certain local varieties of rice, such as Jhalore, Jarwar and Lijura are superior to the " improved " Type 1 as far as their money value to the cultivator is concerned. No. 17, a Government sponsored variety, was first in the broadcasted experiment and second in the transplanted experiment, but not significantly better than the local varieties.

Ramkajra and Type 1 are early varieties ; No. 17 is medium early, and Lijura, Jarwar and Jhalore are late ones. Earliness is a quality which may be considered very desirable for paddy if the field in which paddy is grown is going to have a *rabi* crop. As a result of this year's experiment, No. 17 might be considered suitable for Allahabad district. Even Ramkajra and Type 1 may be preferred because of earliness for such conditions in place of Jhalore, Lijura and Jarwar.

Arhar (*Gajanus indicus*) :—Three varieties, I. P. 80, Local and Magh Mela White were used in the experiment in 1945-46. Out of these three I. P. 80 and Local were selected for this year, and Magh Mela White was dropped due to its low yield, being replaced by Type 51.

I. P. 80, Type 51 and Local were put in a randomized block trial. The plot size was 24′×72′. There were three replications. The yield of Arhar seed from each variety in seers was as follows :—

Type 51	Local	I. P. 80
103	96	89

No significant difference existed between yields of the three varieties so that no one variety is being recommended at this time.

Juar (*Sorghum vulgare*) :—Five varieties of juar were put in a randomized block trial. These were Do-dana Yellow, Do-dona White, Malwa White, 5 tall and 2054. The plot size was 12′×72′ and there were six replications. The

ultimate plot size after removing the non-experimental portions was 8′×68′. The yield of grain in seers of these varieties were as follows :—

5 Tall	Malwa White	Do-dana Yellow	Do-dana White	2054
42·0	39·5	38	33·0	3·0

Yield of dry fodder (*Kubi*) in seers :—

Do-dana Yellow	Malwa White	2054	Do-dana White	5 Tall
672·5	644·0	576·5	572	562·5

The statistical analysis showed that there was no significant difference in the grain yield of the first four varieties. This confirmed the results obtained in previous years. 2054 is an early variety, the grain was eaten by birds and no satisfactory data were secured.

In 1945-46 a *Juar* spacing trail was put in a randomized block layout. The plot size was 20′×72′ and there were six replications. The variety type 9 was put under three spacings, namely, 2′×2½′ and broadcasted. The yield of fodder of these spacings, in seers, were as follows :—

Broadcasted	2 feet	2½ feet
1848·0	1659·5	1594·5

The statistical analysis showed that there was no significant difference in the yields of the above three spacings, although the data showed that broadcasting was better than 2′ and 2½′ under the conditions of the experiment.

Bajra (*Pennisetum typhoideum*) :—The 1945-46 *bajra* experiment included Type 16, Local, Type 4 and Allahabad Hairy. The layout consisted of six blocks of four plots all randomized. The size of each plot being 15′×94′ which became 12′×91′ when two rows on each side and 1½ feet at each end were removed for border effects. The results of the total yields in seers, of grain of the 4 varieties, are as follows :—

Type 16	Local	Type 4	Allahabad Hairy
111·0	110·5	107·0	106·0

The total yield of fodder of these four varieties, in maunds, are as follows :—

Type 16	Allahabad Hairy	Local	Type 4	Sig. Difference
39·1	37·5	36·1	34·9	7·8

There was no significant difference in the yields of varieties last year or this year, when the data were statistically analysed. This year's grain yield of Type 16 has shown that it may prove a promising variety for the Allahabad area.

Gram :—A randomized block experiment was laid out in which I. P. 58, I. P. 56, I. P. 17, Indore 4, Indore 707 and local were included. Out of these six varieties I. P. 58, I. P. 56, Local and Indore 4 were selected for 1945-46. There were six replications and the size of the plot was 12′×48′ but which became 10′×46′ after removing 2 border rows and 1 foot at each end of the plot in order to eliminate border effect. The total yields of gram, in seers, of the varieties, were as follows :—

Local	I. P. 58 and I. P. 56	I. P. 17	Indore 4	Sig. Diff.
45·5	43·5	42·5	30	12·39

Here again it appears that a local variety is better than any of the "improved" varieties, although not significantly superior to I. P. 58, I. P. 56 and I. P. 17. Although I. P. 58, I. P. 56 and I. P. 17 have a better appearance and more uniform grain, it is questionable whether these should be recommended to the cultivator of this area.

Barley :—Five varieties were tested this year in a randomized block experiment. These were T. 20, I. P. 21, 300 A, C. 251 and 35/44. The layout consisted

of six blocks of 5 plots each, the size of each plot being 12′×48′. The ultimate size after removing the non-experimental portion was 10′×46′. The yield of grain in seers, of the varieties are as follows:—

C. 251	300 A	T. 20	I. P. 21	35/44	Sig. Diff.
63 0	55	53·5	48·5	45	6·52

The yield of bhusa in seers:—

T. 20	I. P. 21	300 A	C. 251	35/44
116·5	96·0	81·5	80	79

A full report on the experiment on this crop was made in the Allahabad Farmer, Vol. XVIII, No. 4. A summary report of the experiment on this crop in 1942-43 was also made in the report of the Agronomy Department which appeared in the Allahabad Farmer, Vol. XVIII, No. 5. The result of the experiment last year as well as this year seem to bear out the conclusions arrived at in 1941-42 after a series of experiments carried out for several years, and the results of which were reported as stated above in the Allahabad Farmer.

Wheat:—During the 1945-46 *rabi* seasons ten varieties of wheat were tested in randomized layouts. These were X-1, X-2, X-5, X-7, X-9, X-10, X-11, I. P. 111, I. P. 52 and C. 13. Seven of these, X-1 to X-11, were of the irradiated wheats of Dr. Shri Ranjan, University of Allahabad. I. P. 111 was added to the list this year.

The trials were made in two layouts differing somewhat in size of plots. In layout No. 1, the plot size was 9′×85′. With the non-experimental removed, the plot size was 8′×81′. In layout No. 2 the plot size was 8′×70′ and with the non-experimental removed 6′×66′. The total yield of grain and of *bhusa* for the ten varieties grown in layout No. 1 is as follows. Rust resistance was determined by assuming a maximum value of 6 as rust free and 0 as 100 per cent infected. Each plot was rotted and the total for the six plots for each variety appears under that variety number.

Rust Resistance.

Variety.	X-9	I. P. 52	X-7	C. 13	X-1	X-11	X-10	X-2	I. P. 111	X-5	Sig. Difference
Rotting	22	20	20	18	16	14	13	13	12	6	7·7

Yield of Grain in seers.

Variety.	C. 13	X-9	I. P. 111	X-2	X-11	X-1	X-7	X-10	I. P. 52	X-5	S. Dif.
Yield	28 5	27 5	25·5	22 5	22·5	19·5	18·5	18·4	17·4	16·5	7·4

Yield of Bhusa in seers.

Variety.	X-9	X-10	I. P. 111	C. 13	I. P. 52	X-2	X-11	X-1	X-5	X-7	S. Dif.
Yield	121·5	107·5	105·5	104 5	103 5	103	100·5	98 5	94·5	87·0	29·4

The total yields of grain and *bhusa* in seers for the ten varieties grown in Layout No. 2 are as follows:—

Rust Resistance.

Variety.	C. 13	X-1	X-9	I. P. 52	X-10	X-7	X-11	I. P. 111	X-2	X-5	S. Dif.
Rotting ..	29	25	24	24	23	22	22	22	19	13	..

Yield of Grain in seers.

Variety.	I. P. 111	X-1	X-11	X-9	C. 13	X-10	X-7	I. P. 52	X-5	X-2	Sig. Dif.
Yield ..	68 5	57·5	46·0	42·5	42·0	41·5	37·5	35·0	34·5	34	10·2

Yield of Bhusa in seers.

Variety.	X-1	X-7	I. P. 52	X-10	X-11	I. P. 111	X-9	X-2	C. 13	X-5	Sig. Dif.
Yield ..	232·5	224·5	208 0	207·5	207·5	202·5	195·0	193·0	192·0	175·5	26·5

No one variety was outstanding in the 1945-46 trials. A full report and conclusions will be presented at a later date.

The Farm (S. R. M.)

The total rainfall for the year was only 33 inches as against the nor of 39 inches for Allahabad. Although the monsoon rains started from June 2 they were very light and intercepted by breaks. The first good rain (2·5 inc came as late as July 30. The deficient rainfall accompanied by poor germ tion of the seed conspired against successful production of the main fodder c *juar*. Although the rain in August (13·86 inches) was above normal for month, it, unfortunately, was of little consequence.

This main fodder season was preceded by sub-normal production of sum fodder due to deficient supply of sewage, as reported in the previous rep This was not all. The following period, *i e.*, November, December and Janu was practically rainless. Even in irrigated farming a supplementary sup of rain is necessary for good results. Last year an unusually large quant of fodder had to be purchased for the Institute herd.

Most of the rain in September (4·47 inches) came before the middle of month, and in October (2·32 inches) it came in the third week. So the moist at the time of preparation and of seeding for the *rabi* crops was not very d cient, but the long drought later on as indicated above proved critical. F thermore, between December 15 and January 15 there were as many as fift occurrences of frost of varying intensity, the like of which had not been kno for a long period of years.

Practially, all of the *rabi* harvest, especially that of the wheat, was o by April 9, 1946, and it was that very evening that a rain of about half inch came attended with a strong wind which laid down many roadside tre There was another light rain on April 13. So, while the crops were saved fr the field, they got caught on the threshing floor. The case with village farm in regard to harvesting and threshing was far more deplorable.

The character of the seasons throughout the year as presented above regard to the Institute farm should hold true over a wide area. In fact, t unsatisfactory weather situation of the year seems to have prevailed more less throughout the world. This may have influenced to a considerable ext the present shortage of food-grains on rather a world-wide plane.

Not only were the spring harvests of cereals and fodders affected adverse but also the vegetables. In addition, potatoes suffered artificial vagaries. T purchase of seed potatoes is one thing in the realm of agricultural dealin where direct contact and mutual trust between the producer-purchaser and t producer-seller are more necessary in obtaining good seed than any otl criterion of purchase. The combined control by both the U. P. and Bih Government over Patna potatoes last year made available generally only t worst stuff for seed and that at a late hour. The harvest and sale of ear potatoes was overtaken before half done by the hill potatoes and both suffer due to glut, very low prices and rotting.

However, there were some redeeming features also in an otherwise gloon picture as presented above. Toward the end of the year during summer t sewage supply was better than in the previous summer and with an addition supply of water from another tubewell, the summer fodder situation was e couraging, especially that of the Napier Grass. Even with loss on cultivatic a large quantity of better quality fodders were grown which very considerab helped to keep up the health and milk supply of the dairy herd inspite of t difficulties in securing concentrates for the herd.

A table including the results of crops on the Institute farms for the year is given below :—

Crops	Area	Total yield including grain Mds.	Total cost Rs.	Total Income Rs.	Surplus or deficit Rs.	
Juar & Arhar ..	159·25	13877	10,775	11,823	1,048	plus
Bajra with cowpeas ..	25·01	5272	4,579	2,502	2,077	minus
Guara	1·00	1½	128	8	120	minus
Maize	7·40	221	1,358	370	988	minus
Seed San-hemp ..	26·00	100	2,100	623	1,477	minus
Cowpeas	24·34	1079	2,115	3,000	885	plus
Napier grass ..	16·00	35131	6,434	16,352	9,918	plus
Guinea grass ..	1·30	864	437	446	9	plus
Grasses	..	19,405	9,835	8,069	1,766	minus
Wheat	87·60	643	10,035	12,640	2,605	plus
Wheat straw ..	..	1900	..	..	..	
Barley & gram ..	39 80	180	3,310	3·177	133	minus
Straw	..	863	..	..	..	
Early potatoes ..	8·42	956	4,059	3,315	744	minus
Hill potatoes ..	8 05	782	3,531	1,791	1,740	minus
Vegetables ..	11·40	1,237	5,346	3,125	2,221	minus
Berseem	4·70	447	1,334	298	1,036	minus
Oats	7·90	351	1,021	332	689	minus
*Lucerne & Shaftal ..	6·70	1133	1,433	980	453	minus
Miscl. crops ..	5·03	691	1,400	688	712	minus
Sugarcane ..	5 60	2,692	733	2,052	1,319	plus
Rain-Fed Farm ..	40·00	890	4,394	2,736	1,658	minus
			74,357	74,327	30	minus

The above cost figures include an amount of Rs. 5,433 as interest charges for the use of land and operating expenses on the crops, in order to make the cost of production complete. However, interest charges are not made yet in the internal accounting system of the Institute, and in this context, the above table would show a surplus of Rs. 5,403, where there is a net deficit of Rs. 3%.

There are many causes in bringing about the above unsatisfactory result of farming this year. Only a few outstanding ones may be mentioned. First is the weather and its effects, as already presented above. Second is the unimproved soil on the larger part of the farm area. Third is the educational character of the Institute and its effects even on the commercial aspects of its activities. Lastly, but of special importance, is the fact that while the farm has borne the full effect of higher cost of cultivation, the effect of rise in prices has not been realized correspondingly. The institute itself is the biggest consumer of what it produces in the way of fooder and byproducts. These have been debited to cattle account at almost the same prices as in 1939 until the middle of the last year when the prices were revised. The second big customer is the Government at Government prices. The third is the open market for most of the vegetables, the situation regarding which has already been described above.

Reverting to the aspect of higher cost of cultivation, a table is given to show the situation with the labour cost on the farm. The figures of labour

*Lucerne and Shaftal account as given above is still incomplete. This being a perennial crop the full accounting period runs from October to September.

employed and the cost of wages for 1938-39 have been assumed as normal or 100 per cent—

Year.	Total Man-days.	Per cent of 38-39.	Total wages cost.	Per cent of 38-39.
1938-39	33541	100 per cent	9675	100 per cent.
1939-40	31880	95 ,,	9283	96 ,,
1940-41	32009	95·4 ,,	9134	94·4 ,,
1941-42	31206	93 ,,	9412	97·3 ,,
1942-43	36481	109 ,,	14652	151 4 ,,
1943- 4	52507	156 5 ,,	29058	300·3 ,,
1944 45 .. .	63529	189·4 ,,	40003	413·5 ,,
1945-46	59354	177·0 ,,	39948	412 9 ,,

There is not much outstanding to note for the first four years of war, that is, 1938-39 to 1941-42. It was from part of 1942-43 that the effects of war began to be felt and felt in a fast rising trend. The wages increased much more sharply than the rise in the recruitment of labour.

It was from the middle of October 1942 that the new tube-well on the farm came into operation. It resulted in increased cropping intensity and an earnest effort had to be made to get in more labour. From April to October 1942 the average monthly labour force was only 2466 man-days as against 3844 from November 1942 to March 1943.

However, whether before 1942-43 or after, the full labour requirement of the farm has not been met. When it did become available in larger amount. it was mostly the inefficient class—a large number of women, boys and girls rather than men.

Labour is the major item in the cost of production of crops. It is 54 per cent of the total cost in the year under report. In somewhat the same proportion the cost of feed and materials has increased too.

May our India
Our ancient land unto herself return
O once again return to steadfast work,
To duty and devotion, to her trance
Of earnest meditation! Let us sit
Once more unruffled, greedless, strifeless, pure.

—RABINDRANATH TAGORE.

REPORT OF AGRICULTURAL ENGINEERING DEPARTMENT, 1945-46.

By

MASON VAUGH.

The year under report continued to be one of difficulties and in some cases disappointments as well as of encouragements. The ending of the European phase of the war just before the commencement of the year under report and of the Eastern phase not long after, eased some difficulties but not many.

There were no important changes in the staff during the middle of the year under report. Several took place at the end of the year, when Mr. Strong took leave in India, before going on furlough, to help another mission with urgent problems. Mr. S. S. Bhatnagar left to take a post in the Government Agr. College at Cawnpore and Mr. Basu to take up other work. Mr. M. H. Khan was on temporary appointment from July till December, when he resigned expecting to sail for foreign study. Mr. Nandy continued through the year as senior research engineer as passage was not available for him to go for foreign study till after the end of the year. He sailed late in July 1946. Mr. B. D. Sharma joined as second research engineer in September. Mr. B. K. Mukerji resigned from the bullock research scheme in May to become workshop Superintendent of the Institute workshop. Mr. Hokindro Roy, B. Sc. (Agr.) joined in July and served through the year as animal husbandry research assistant in the bullock research scheme.

Difficulty in getting materials continued to plague us through the year. A wagon load of steel shipped from Calcutta in September never did arrive and is still untraced. Other steel ordered in the early part of the year was only received at the end of the year and part of that was taken over by the United Provinces Government workshop at Cawnpore for use in building implements under their scheme. With great difficulty we were able to secure one wagon load of cement, and small amounts of iron for building work. We were allotted 20 wagon loads of coal for brick making but none of this was received, wagons not being allotted. Fortunately, we were able to get 100 tons of coal from surplus military stock at Allahabad and with it got enough brick to carry on. At the end of the year, with the exception of brick, the material situation was just about as bad as ever, worse in that *kankar* lime of which we had been able to get sufficient before began to run short.

In spite of the difficulties, we were able to complete the block of 5 quarters in connection with the Jamna Dispensaries and to complete the second storey on the central portion of the Men's Hostel No. 2. The latter was not completed until after the opening of college in July and some fittings will not be finished till later in the year. At the end of the year, in addition to the hostel, work was proceeding on a new kitchen attached to the dining room of No. 1 Men's hostel to accommodate a " cafeteria mess " featuring self service, believed to be the first one of its kind in India. It is hoped that this will solve many of the problems formerly associated with hostel dining arrangements. Projected for the next year are one additional staff bungalow, a block of three semi-detached staff quarters, alterations to improve and extend certain other staff quarters and building of the East wing of Men's Hostel No. 2, at least in part.

In connection with the Higginbottom Recognition Fund, plans were under preparation at the end of the year for the new Library-Administration building which is to include an assembly hall as well, for the new Science building and for the buildings for Horticultural and Agronomy buildings. The site plan for the new buildings was nearing completion. It is hoped that the plans for these new buildings can be finalised during 1946-47 so that if and when building materials and labour become more plentiful, construction can proceed rapidly.

The worst shortage in labour is that of carpenters, the large demand for them causing acute difficulty.

The receipt of fairly large amounts of steel near the end of the year enabled us to resume active construction of implements and fairly large deliveries of plows were made at the end of the year. It is expected that by September 1946, the large accumulation of back orders can be cleared off more or less completely and we can begin offering deliveries from stock. Some additional material is expected also which will further ease the position, particularly some high carbon steel for shares.

More stable as well as more experienced research staff has allowed better progress in implements research. During the year, improved versions of several implements, particularly for interculture have been worked on. A new knife harrow was built and used experimentally A three row seeding attachment for the Shabash cultivator was made and tested, with encouraging results, on the *rabi* crop. Further tests as well as the application of it to the Wah Wah cultivator will be carried out. A new type of hand power churn was designed and drawings prepared but shortage of labour has not allowed its construction as yet.

The blower for the seed dryer mentioned in last year's report did not arrive till after the end of the season for its use. It did arrive later and the dryer will be tested during the next year. Tests were made on the bullock gear driven chaff cutter. The cutter performed reasonably well but the gear again gave trouble Results are not encouraging, mainly because of the small amount of power available. The use of a small engine or, where the current is available, small electric motors, appears much more promising. Work along this line is projected for the future.

The work of the department for the following year will certainly be handicapped by the lack of trained staff. The absence of Mr. Strong on furlough, of Mr. Nandy on study leave for two years and the prospect that he may be required to serve Government on his return and the necessity of replacing Mr. Basu and Mr. S. S. Bhatnagar, are all unfavourable factors. Mr. S. C. Bhatnagar, the only remaining engineer on the staff, beside Mr. Vaugh, with both agricultural and engineering training, has been called for interview for a foreign scholarship* and has been offered two other posts elsewhere. Negotiations are under way for the release of Mr. E. J. W. Moraes from the army and it is hoped that he will take Mr. Bhatnagar's place if and when he goes on study leave. Efforts are being made to add another American agricultural engineer to the staff but no suitable man has been found as yet.

The subject of agricultural engineering is receiving gratifying recognition in India. Out of 26 graduates in the subjects, two have been awarded foreign study scholarships and it is expected that one more will be sent within the current year*. Increasingly, the qualification of a degree in agricultural engineering is being specified for posts advertised and practically all graduates in the subject have had the choice of more than one job within a few months of graduation. While there are difficulties in the working of the agricultural engineering department of the Institute, they are largely the difficulties generally associated with a new development, "growing pains", and are largely the symptoms of the demand and need for the training. We look forward to the future, confident of the contribution that agricultural engineering can make to the solution of the food problems of India, so acute at this time.

* Since the close of the year under report, Mr. Bhatnagar has received his appointment for foreign study and expects to proceed to America as soon as passage is available, probably in October.

REPORT OF THE DEPARTMENT OF HORTICULTURE, 1945-46.

By

W. B. Hayes, Theodore Dean, and Mohammad Sharif.

The orchards have continued to produce fairly satisfactory crops, and as prices have remained high, operations have again been profitable. Many problems, however, remain to be solved, and only a little has been done to find the answers.

Real progress was made in solving one problem which has bothered us for years. Figs of several varieties have been grown at the Institute for a number of years, but while they have flourished and flowered freely, almost no mature fruits have been produced. The young syconiums would remain on the tree for weeks, and fall off without developing any pulp or seeds. They behaved as if they needed pollination, but figs, except for the Smyrna type, ordinarily develop without pollination. The same varieties which failed here produced fruit in Poona, Saharanpur, and even Lucknow, and nothing seemed to be known of any pollination there.

Rao reported in 1944 that he had succeeded in producing mature figs of varieties which ordinarily behaved like the figs at Allahabad, at the Fruit Research Station at Kodur in Madras. He did this by opening the eye of the fig, inserting a bamboo needle into a young syconium of the wild fig (gular), *Ficus glomerata*, and then into the fig through the eye. This apparently effected pollination. An attempt to use this method at the Institute was unsuccessful, perhaps because of faulty technique or because the wild figs were not at the right stage to provide pollen.

In the spring of 1945, Mr. Sharif, while still a student, attempted to bring about pollination by scattering syconiums of *F. glomerata* arround the fig trees, and fastening some to the branches. After becoming a member of the staff, he noticed that the trees so treated had produced mature figs of satisfactory quality, and by repeating the treatment, he secured another crops. Seeds taken from these fruits have germinated and the seedlings are growing. This indicates that fertilization was effected, and that the failure of the fruits to mature previously was almost undoubtedly due to lack of pollination. This method would appear to be more easily applied than that of Mr. Rao, and if it continues to give good results, may be of great importance to the fig industry. Much remains to be discovered as to the best time and method of applying the wild figs, and as to the exact means of pollination. This is probably the insects which are commonly found in the wild fig.

It is fairly commonly known that the seeds of some species of citrus fruits germinate satisfactorily when removed from immature fruits. In 1945 Singh reported that in the Punjab seeds of the *karna*, rough lemon, and lemon were viable before the end of August and that there was a decrease in the percentage of germination after early September, although the fruits were not ripe until mid-winter. This finding was confirmed by Mr. Dean for the *karna*. This fruit, which is probably a hybrid, but which has been called *Citrus karna*, is the most important rootstock in the United Provinces and is also used in other parts of the country. Two hundred seeds were planted each month from September through February, 1946. The percentage of germination and the time required were noted as follows: September, 87·5%, 14 days; October, 84%, 14 days; November, 80%, 78 days; December, 53·7%, 53 days; January, 52%, 31 days; February, 16·6%, 30 days. By the latter part of January the temperature begins to rise, and the results indicate that the time required for germination may be influenced by the temperature. The viability of the seeds, however, seems to decrease with maturity. Seeds planted in September in Allahabad should give many seedlings ready for building the following July.

Transportation difficulties have continued to interfere with the introduction of new varieties, but a few have been secured and are being tried. These include two pummelos, Stalkarta and No. III of the Agri-Horticultural Society of Bengal, and one of Mango, Dilpasand of Murshidabad. Seedlings have been grown from seeds of several American varieties of guava, and have now been planted in the variety orchard for testing Some of these are types with sour fruit, suitable for making jelly without additional acid. Seedlings of a variety of papaya, kakri, presented by a student, are also under trial.

There are occasionally enquiries as to which varieties of the sweet (Malta) orange do best in this area. A considerable number of varieties have been grown at the Institute, some with fair success. One which now seems very promising is the Mosambi. A tree secured from a government garden in the United Provinces under this name has not done very well, and the fruit is not very typical. A younger tree secured from Poona has now been bearing good crops for several years. The tree itself seems more healthy than many of the sweet oranges, but this may possibly be because the species does better on the rough lemon root stock than on the *(karna khatta)* used here. The fruit is somewhat lacking in acidity for some, but this type is popular on the market.

Diseases continue to cause serious loss, particularly the *Cephalospora* disease of the guave, which caused the death of some 20 trees during the year. No remedy is yet known. Work on diseases of the papaya is being reported elsewhere by Dr. Vestal. Damage from wither-tip disease of the citrus fruits was almost entirely absent this year, after being comparatively severe for several years.

Insects have also been present. For several years the number of giant mealy bugs on the trees seems to have been increasing, and this year the number present on the citrus trees in parts of the orchard was sufficient to cause real damage. Custard apple and other trees were also affected. Attempts to control the pest with the insecticides D D T and Gammexane (666, benzene hexachloride, hexachlorocyclohexane) failed, but a tobacco concoction seemed fairly effective.

Various fruit products, including bottled juices, continued to be popular.

The need for a suitable text-book in pomology has long been felt. Mr. Hayes was writing such a book and publishing it in parts on loose sheets over a number of years. This has been revised and was published during the year by Kitabistan, a publishing house in Allahabad. While designed primarily for students, it is being found useful by growers and amateur gardeners also.

"Every step mankind has taken has been Spirit led. Every new discovery has been God's revelation of Himself. With every new blaze of light man comes nearer to the central Power over the world."

REPORT OF THE BIOLOGY DEPARTMENTS, 1945-46.

During the academic year 1945-46 Mr. W. K. Wesley was on study leave from the Department and Edgar F. Vestal was in charge of the work. As this report is being written Mr. Wesley has returned to become Head of the Department and Dr. Vestal is officiating Head of the Department of Agronomy. During the absence from the Department of Mr. Wesley, Mr. H. H. P. Sharma took care of the classes in entomology and zoology. Mr. S. R. Barooah is on leave of absence while studying for a Ph. D. in the University of California, U. S. A., Mr. T. A. Koshy, who, with his wife, has been on leave of absence for the past two years studying for an advanced degree in Botany and Plant Pathology at Ohio State University, U. S. A., expects to return this fall to resume his duties in the Department. Mr. L. C. Nott has been advanced to the post of Lecturer in the Department and is also taking an active part in the research in plant disease.

Besides the regular students, a number of special students have been given instructions in both theory and practice. Students from the University of Allahabad M. Sc. classes in agricultural botany and zoology have also been given aid in their research problems.

BOTANY SECTION

Edgar F. Vestal and L. C. Nott—

Most of the extra classes activities of the Botany Section have been in the field of plant pathology and plant breeding in co-operation with the other department of the Institute. During the 1945-46 *Kharif* and *Rabi* crop seasons, some 65 different plant diseases were observed on the crop plants on the Institute Farm and neighbouring village fields. The casual organs were either identified on the host plants in the field, or isolated and studied in the laboratory. Some of the cultures were sent to the Mycology Section of the Imperial Agricultural Research Institute, New Delhi or to the Botany Department of the University of Allahabad. A portion of the seasons observations were reported in the Janury and March issue of the Allahabad Farmer (2). In this report the weather for the months of June to October was summarized and the effect of the weather upon the fungi observed on the plants commented on. In this report the weather of the *kharif* season will not be given special place, but only in comparison to that prevailing during the *rabi* season.

Weather conditions during the *rabi* season were essentially the same as during the *kharif* season. Figures Nos. 1, 2 and 3 and tables Nos. 1, 2 and 3 contain the data for the two seasons of 1945-46 and Tables 1, 2 and 3 for the corresponding seasons of the previous five-year period. Rainfall and humidity were generally lower for the 1945-46 season than for the 6 year average shown on the graphs. On the other hand, the temperature was higher during the months of July, August, September, January and February. Observations on the crops grown on the Institute and neighbouring village farms were recorded and the more important ones are presented in this report. They will be taken up crop by crop.

Wheat—

Germination of the October 1945 planting of wheat appeared fair, but there was an observed dying of the seedlings after reaching a height of some two inches. Estimated deaths amounted to some 25 per cent. Examination of the roots disclosed many dead and others with diseased areas. Isola-

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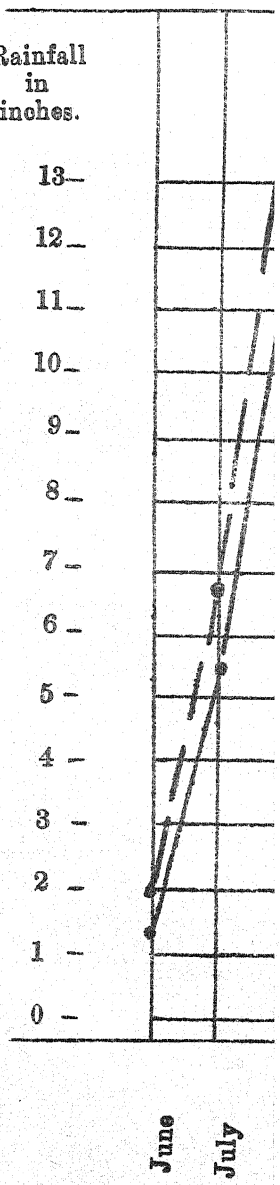

FIGURE No. 2.

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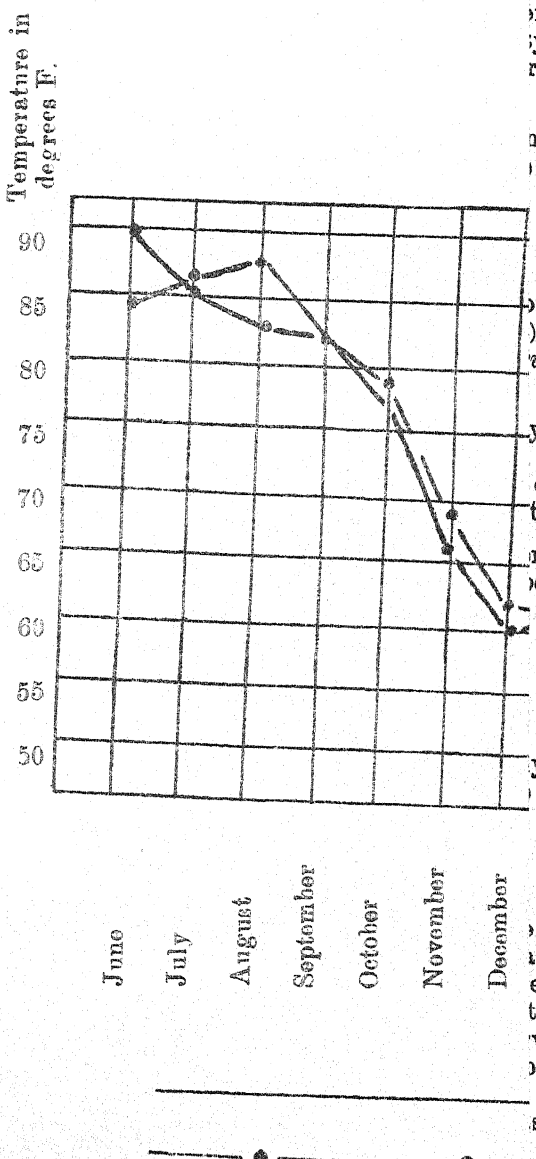

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FIGURE No. 1

Rainfall Data Collected at Allahabad Agricultural Institute Farm for the Months of June, 1945, to March, 1946, compared to the previous 6-year period for the same Months.

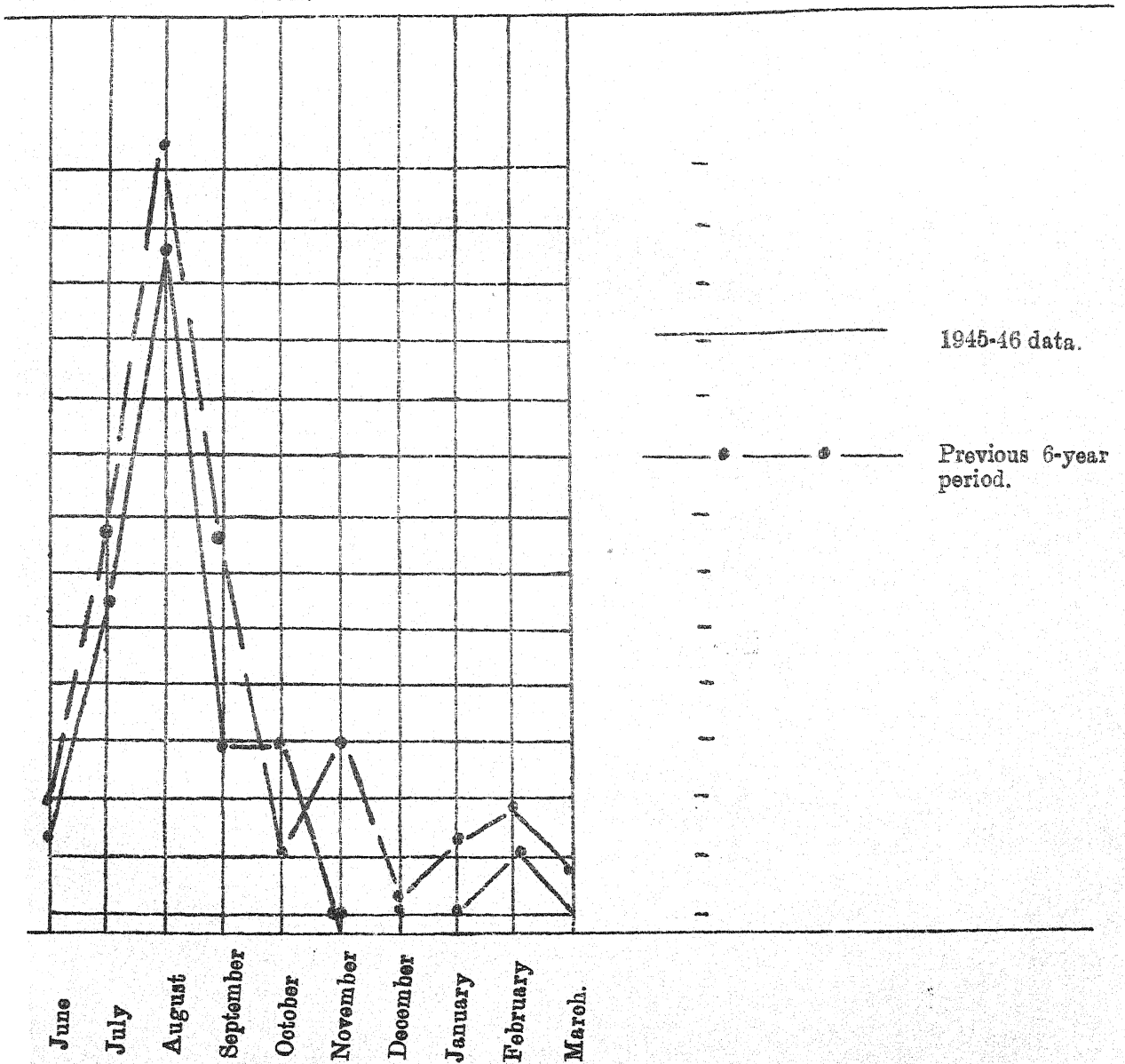

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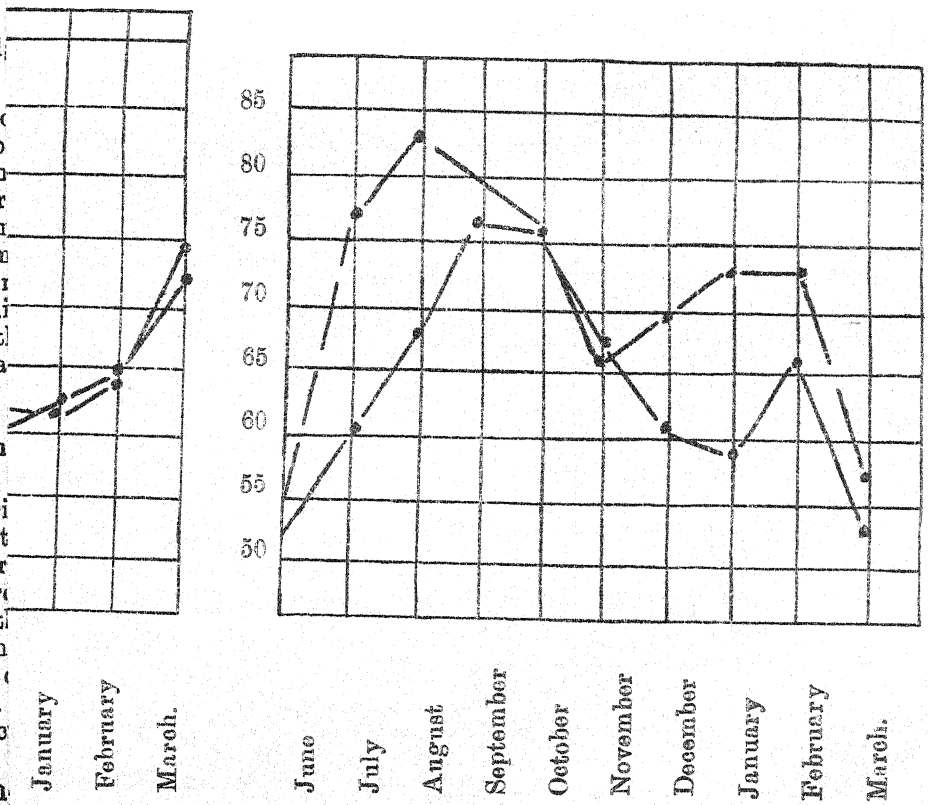
FIGURE No. 3.

Humidity Data Collected at Allahabad Agricultural Institute Farm for the months of June, 1945, to March, 1946, in comparison to the same data for the corresponding months of the previous 6-year period.



tions from these diseased roots yielded a species of *Pythium* and of *Rhizoctonia solani*. Using pure cultures, sterile soil and the same variety of wheat as that from which the isolations were made (X-9) it was found that the two fungi together reduced the emergence approximately 25 per cent which corresponded to the field estimations. Pythium alone reduced the emergence about 10 per cent and Rhizoctonia about 6 per cent. This would indicate that they were more active when together than when separate. The Pythium culture has been sent to Dr. R. K. Saksena of the Botany Department, University of Allahabad, who kindly consented to carry out its identification.

The first appearance of any of the rusts on the Institute Farm was February 9. On the same day it was discovered on local wheat on a village farm near by. All three rusts were found in the same area at the same time. The extent of the infections indicated that they had not been there for a very long period. The area was low and sheltered and it was some time later before the rusts appeared on the uplands. This date is at least six weeks later than the expected date of appearance for rusts in this area Low humidity and rainfall were, no doubt, important factors. The humidity for January (see Table No. 3) was 14·90 per cent below the 6-year average for this area.

Loose smut was found on the local wheat growing on a village farm near the Institute, but did not appear on any of the varieties grown on the farm itself.

Barley—

Disease symptoms, characteristic of barley stripe, were observed on the barley in a low lying area. However, the *Helminthosporium* (*H. gramineum*) commonly associated with the stripe disease was not found. A species of *Curvularia* was isolated from the diseased tissue.

Stem and stripe rusts were observed on barley at the same time they were first seen on wheat. Damage was slight as the spread, although rapid, came very late. At harvest time there was considerable rust to be found on the leaves of the barley, but it is not thought that much loss to the grain resulted.

Covered smut (*Ustilago hordei*) was present to the extent of some 10 per cent. Species of *Helminthosporium* and *Sclerotium rolfsii* were isolated from roots of barley plants that were observed dying in the low areas.

Losses due to root rots were probably 15 to 20 per cent in these areas.

Oats—

Oats were exceptionally free from leaf spotting fungi and only one variety, (Local) was attacked by smut. Loss, in this case due to loose smut (*Ustilago avanae*) was estimated at 10 per cent.

Jowar—

Red spot (*Colletotrichum gramnicolum*) caused losses estimated to be about 10 per cent. A species of *Cercospora* was found causing a trace of damage. A species of *Curvularia* was found on the seeds at harvest time and the pathogenicity established by Dr. W. N. Rice, who had worked with the fungus in the United States. A species of *Helminthosporium* was also observed on the germinating seeds when plated on 2 per cent agar in petri dishes but the pathogenicity was not established. Very little smut was observed on jowar during the 1945·46 season. A trace of grain smut (*Sphacelotheca cruenta*) was seen.

Bajra—

Kernel smut (*Tolyposporium penicillariae*) was observed to cause some 10 per cent of damage to grains at harvest time. *Sclerospora gramnicola* caused losses up to 5 per cent. *Choanephora* sp. was abundant on the flowering heads and it may be that was responsible for some of the poor seed set. In the field, root rot was responsible for the death of many plants. A *Fusarium* was observed on the roots of dying plants and when placed in a moist chamber growth of the *Fusarium* was abundant.

Maize—

Leaf spotting of maize was caused by species of *Cercospora* and one of *Curvularia*. The *Curvularia* appeared identical with the one isolated from jowar and at this time experiments are being conducted with a view to determine the extent of the host range among the cereals, whether seed borne or not and whether the isolations are identical.

Sugarcane—

Little disease appeared on sugarcane during the season of 1945-46. Red rot (*Colletotrichum falcatum*) caused damage to the extent of some 1-2 per cent.

Linseed—

Linseed rust (*Melampsore lini*) was first observed on linseed in a neighbouring field on February 9. It was first observed on the Institute Farm on February 20-but was in isolated areas. By harvest time the infection had caused damage estimated to be about 5 per cent. Root rot was in evidence but a study of the fungi was not made.

TABLE No. I.

Total Rainfall in inches for the months of June to March, inclusive, for the Crop Seasons 1940-46 *inclusive at Allahabad, India.*

Year.	Month.									
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.
1940-41 ..	0·80	4·37	14·72	5·60	0·12	0·00	0·00	1 03	0·20	0·00
1941-42 ..	2·74	5 72	5·28	8·65	0 04	0·00	0·00	3·96	4·30	0·36
1942-43 ..	4·52	7·10	9·98	8·22	0·00	0·00	0·16	0·57	0 22	0·00
1943-44 ..	0·80	8·29	19·78	8·78	0·74	0·00	0·00	0·00	4·58	4·38
1944-45 ..	1·09	8·64	19 04	4·98	2·09	0·00	0·90	2·00	0·00	..
1945-46 ..	1·21	5·62	11·65	2 91	2·97	0·00	0·00	0·00	1 00	0·00
Average ..	1·86	6·61	13·41	6 52	1 003	0·003	0·176	1· 6	1·71	0·95

TABLE No. II.

Mean Temperature in degrees F. for the months of June to March for the Crop Seasons 1940-46, *inclusive, at Allahabad, India.*

Year.	Month.									
	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.
1940-41	93·72	83·38	83·19	83·45	80·30	69·48	63·00	60·78	64·64	75·95
1941-42	89·60	86·40	83·70	83·20	80·10	67·63	62·22	59·76	64·80	75·60
1942-43	94·34	83·75	82·38	81·72	78·50	88·23	60·85	66·07	63·14	75·92
1943-44	92·88	85·63	80·80	83·50	76·84	67·89	61·28	60·54	62·54	73·70
1944-45	82·65	86·95	81·33	79·45	74·62	68·38	62·60	59·56	68·19	..
1945-46	84·30	85·90	86·32	82·75	75·92	65·66	59·70	61·91	64·34	72·45
Average	89·58	85·33	82·95	82·31	77·75	67·54	61·61	61·43	64·61	74·72

TABLE No. III.

Average Humidity in per cent for the months of June to March, inclusive, for the Crop Seasons 1940-46 *at Allahabad, India.*

Year.	Months.									
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.
1940-41	48·30	78·00	83·70	73·50	58·00	52·20	71·80	78·96	66·58	41·55
1941-42	63·56	70·36	83·62	83·20	80·60	53·42	89·96	80·22	77·65	59·76
1942-43	49·08	86·24	79·25	79·52	76·08	74·00	81·03	61·77	75·70	51·59
1943-44	56·8	72·60	93·24	88·00	83·95	73·89	78·84	81·62	81·66	78·80
1944-45	54·70	89·60	88·55	78·76	78·86	69·83	53·80	58·60	..	..
1945-46	53·00	60·65	67·47	76··2	75·50	67·44	60·70	58·30	64·89	52·68
Average	54·25	76·24	82·64	79·68	75·97	65·13	69·44	73·24	73·25	56·87

Gram—

Rust (*Uromyces ciceris-arietini*) was found on the Institute Farm, by Dr. R K. Saksena and his students, on March 9th, but only a trace was observed. Root rot appeared in some areas but was not studied.

Groundnut—

Four varieties of groundnuts were grown on the Institute farm this past season. These were Akola No. 10, Akola hybrid 12/24, Akola hybrid 34 and Akola hybrid 1. There were several plant diseases which appeared on the ground-

nuts. *Sclerotium rolfsii* and a species of *Fusarium* was isolated from the roots of plants found dying in the Akola No. 10 area. *Colletotrichum lagenarium* also appeared in the cultures. *Cercospora* leaf spot was present on all varieties but worst on the Akola No. 10. From the data collected during the past year Akola No. 10 appears to be too susceptible to root fungi to be good for this area.

Arhar—

Fusarium root rot was found on arhar to the extent of some 1 to 2 per cent. Leaf spotting fungi were not evident as in former seasons. This was in line with the observations made on the other crops and which were considered to have been definitely influenced by the low humidity and rainfall.

Sann hemp—

The remarks about arhar may also be said of sann hemp. Root rotting fungi caused a trace of loss. Leaf spotting fungi were absent although it was unofficially reported that the sann hemp in the vicinity of Benares was being severely damaged by a species of *Cercospora*.

Cow peas—

Leaf spotting fungi caused a loss of perhaps 1 per cent. Among the fungi causing leaf spotting was a *Cercospora* sp. and one unidentified fungus.

Sweet potato—

The sweet potatoes were unusually free from any trouble from fungus diseases during the past season. An occasional leaf spot was all that was observed.

Irish potato—

Irish potatoes were infected with mottle leaf, leaf soll, crinkle and spindle tuber of the virus diseases. Estimations, based on 100-plant counts, were that some 20 per cent of the early potatoes were infected with probably 5 per cent loss in yield. Later potatoes were not nearly so badly infected. *Cercospora* leaf spot and early blight (*Alternaria solani*) were present in the early plantings as a trace.

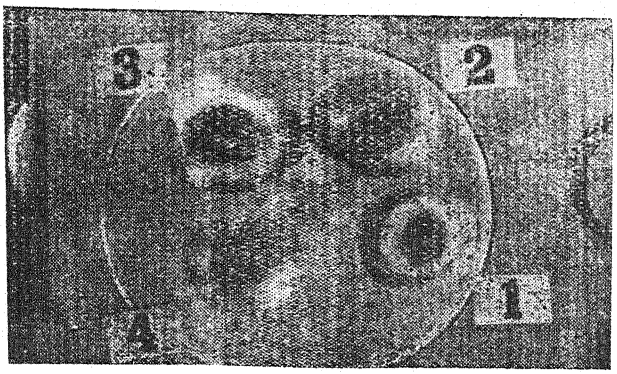
At harvest time the late plantings were found infected with a tuber rot which caused a loss, by weight, of 7½ per cent. Isolations at digging time yielded a culture of *Macrophomina phaseoli* (identified by Mr. B. M. Gupta, Imperial Agricultural Research Institute, New Delhi) and a bacterium. The bacterium was not identified, but the odour of the rotting potatoes and the fact that it was a gram positive, rod shaped organism indicated that it probably was the common soft rot organism, *Bacterium carotovorus*. The rot in storage was much more rapid as a result of the activity of the bacterium than of the *Macrophomine phaseoli*. Loss was probably between 10 and 15 per cent.

Tomatoes—

Virus diseases were the most serious to be seen on the tomato crop during the 1945-46 season. Early season losses due to virus diseases were probably 10 per cent, but the late season plants suffered an estimated 90 per cent loss. There was some *Fusarium* root rot and some leaf spotting caused by *Alternaria solani* and *Cercospora* sp. *Rhizoctonia solani* was also isolated from the diseased roots.

During the early part of the season there was a green fruit rot which developed and which destroyed at least 60 per cent of the early set of fruit. Practically 100 per cent of the fruits touching the ground rotted in the course of about two weeks. Isolations from the rotting fruit yielded a species of *Pythium* and

Rhizoctonia solani. Inoculations, in co-operation with Dr. W. N. Rice, demonstrated the pathogenicity of each. See Figure No. 4.



Key to the numbers.

No. 1. Pythium alone.

No. 2. Rhizoctonia alone.

No. 3. Pythium and Rhizoctonia together.

No. 4. Control.

Photo by W. N. Rice.

Figure No. 4.

When Pythium was used alone and inoculated into the flesh of a surface sterilized green fruit of about 2 inches diameter the infection was rapid. Within 36 hours the fungus had progressed through the fruit and within 48 hours a thick mat of the fungus was formed over the upper portion similar to that observed in the field. When Rhizoctonia was used alone some 4 days were required to pass through the tomato fruit. When Pythium and Rhizoctonia were used together the time required for the appearance of the fungus at the top of the fruit was about the same as when Pythium was used alone. Rhizoctonia did not form any clearly visible web of mycelium.

As the season progressed the rooting became less and less severe so that by the time the crop was 75 per cent over there was little of the soil rot. Temperature and humidity were both below the normal for the month of March, but it was probably the lower humidity which was the more important factor in reducing the green fruit rot. Those fruits which did not touch the soil, or which did not lay in contact with other fruits touching the soil, did not become infected with the two fungi. Thus it would seem that by trellising the plants, and thus raising the fruits off of the ground, the loss might be reduced very greatly. This is the plan for the coming year.

Chillies—

The same virus diseases which were found on tomato were also found on the chillies plants. A small amount of anthracnose (*Colletotrichum nigrum*) was observed, but the damage amounted to little more than a trace (0·01) *Cercospora* and *Alternaria* leaf spotting fungi were also evident as a trace. Virus diseases accounted for at least 50 per cent of the crop of fruit.

Cucurbits—

Virus diseases were the most severe of the diseases observed on the Cucurbits. Estimations of loss are difficult to make, but fully 90 per cent of the plants were diseased and the loss to the fruit crop must have been considerable. The squashes and pumpkins were also infected with a *Choanephora* species (probably *Choanephora cucurbitarum*) Powdery mildew (*Erysiphe cichoracearum*) was also found on many of the leaves it probably did little damage however.

Brinjal

The brinjal leaves were attacked by a species of *Cercospore* (probably *C. solanacea*) and some damage to the foliage was done. Other leaf spotting fungi were present but were not identified. The most serious loss of all was caused by the stem borer which destroyed nearly all of the first lot of blossoms. Hand killing was effective to a certain extent, but for too many escaped to continue their destructive work. Choanephora was also present.

Bhindi

Virus diseases caused severe loss to the bhindi crop. It appeared that the virus diseases were spread about by the red cotton bug which was present in large numbers. This coming season it is planned to work in co-operation with the Entomology section in a series of experimental control measures. Preliminary trials with D. D. T. in dust failed to stop the red cotton bug.

Garden Beets

Garden beets were attacked by *Cercospora beticola* but little damage done. During one attempt to isolate the *Cercospora beticola* a culture of *Colletotrichum lindemuthianum* was secured. It is not suggested that the bean anthracnose is parasitic on garden beets, but may have been living on a *Cercospora* lesion as a saprophyte.

Mung—

Mung was attacked by *Cercospora cruenta* as usual and defoliated.

Papaya—

During the latter part of the *kharif* season the papaya trees in one of the old plantings were dying rapidly. In co-operation with the Department of Horticulture careful examination of a large number of the trees was made. The roots systems were found to be badly decayed and in many cases were badly deformed by root knots which had been caused by nemetodes (probably *Heterodera merioni*). From the diseased roots, species of *pythium* and *Fusarium*, together with *Rhizoctonia solani*, were isolated. Young trees in a newly planted orchard of papayas were also dying. Following the directions given by E. I. du Ponts de Nemours and Co., the soil, where the young trees died, was drenched with a 2 per cent solution of formaldehyde. After allowing the area to stand for a few days, until the formaldehyde could dissipate into the soil, young seedlings were replanted in the same area. Careful records are being kept to determine the value of the treatment. Mr. Theodore Dean of the Horticultural Department has mapped the area and marked all of the transplants, and up to the present time he reports none of them have died. A few others are dying, but they may be suffering from some other cause.

Lack of controlled conditions have made the experimental work slow and much work is left to be done. *Pythium* appears to be the most virulent of the fungi so far isolated. Isolations have been made from diseased roots from a depth in the soil of at least 16 inches.

Leaf diseases were observed and a species of *Phyllosticta* was isolated. Comparison of the spores with those of the fungus described by Chaudhury(S) make it appear that they are not the same as the spores of the fungus described in Assam. Spore measurements for this fungus being 5·7×3·5 microns when grown on oat meal agar.

The fruits were attacked with a fruit rot and *Colletotrichum Lagenarium* was isolated from the diseased fruits. Mr. L. C. Nott proved the pathogenicity by inoculation and re-isolation of the fungus.

Citrus—

Citrus canker was present on a number of the susceptible varieties during the season. In some cases causing damage up to 15-20 per cent. Limes and grape fruit trees were among the most severely damaged. In one instance an isolation, from a tree infected with a disease resembling scab, proved to be a *Colletotrichum*. It appeared more like *C. limmonettum* than any of the other known species found on *Citrus*. In March of 1946 a species of *Colletotrichum* was isolated from dead and dying twigs of Citrus but has not as yet been identified.

Jackfruit twigs and leaves found dying yielded a fungus closely resembling *Colletotrichum lagenarium*.

Seed Germination Trials.

In co-operation with the Agronomy Department and the Farm, seed germination trials were conducted to determine the percentage of loss of vitality during the storage period. As jowar seed had been giving a good deal of trouble, because of low germination during previous year, it was made the subject of the most intensive study. The germination tests were carried out in the laboratory of the Biology Department. The seeds were first surface sterilized for from 1 to 2 minutes with a 0·2 per cent bichloride of mercury solution, washed in sterile water and planted out on a 2 per cant agar solution in petri dishes. Germination at the time of harvest varied from 78 to 88 per cent for the different varieties and from different portion of the farm. From 40 to 74 per cent of the seeds bore various kinds of molds. When the little seedlings were permitted to grow on the agar plates for a week the survival count showed a death loss of from 14 to 33 per cent with an average of 28 per cent. These deaths were due to fungi growing on the seeds and seedlings. Examination of the fungi disclosed that *Mucors, Rhizopus, Fusarium* and *Curvularia* were among the many seen on the seeds and seedlings. Dr. W. N. Rice, who has been working with a species of *Curvularia* in the U. S. A. carried this isolation through Kock's Postulates thus proving its pathogenicity. When seed treatment with Semesan, Barbac C, Arasan and Spergon was done and the treated seeds planted on the agar plates, germination varied from as much as 39 per cent in favour of the treated to as much as 4 per cent against the treated. The average increase due to treatment was approximately 25 per cent with Spergon being the most consistent. The first trials were made in March. A second trial of the various treatments and lots was made in June, just before planting, with results so close that it was evident there had been no significant reduction in vitality due to the standing of the seeds in the various chemicals.

Maize seed germinated in March gave germination percentages ranging from 90 to 99 per cent with from 2 to 12 per cent of the seeds producing fungi. Fungi appearing in most abundance were species of *Curvularia Aspergillus, Penicillium Mucor* and *Rhizopus*. The *Curvularis* appeared to be identical with the isolation from jour seed. Recently, a gray streaking appeared on the leaves of maize on the farm, which appears to be caused by the same fungus, and a series of experiments is being carried out by Mr. L. C. Nott to determine whether the isolation from the jour seed, the one from maize seed and the one causing the streaking of the maize leaves may be the same thing and, if the fungus is seed borne, whether seed treatment may aid in its control. More recently a species of *Helinmthosporium* has appeared on maize and is causing severe damage to the leaves.

Seed Treatment Trials.

In co-operation with the Department of Agronomy and the Farm, a number of seed treatment experiments are being carried out. For these experiments, Barbac C, (American Cyanamid Company), Arasan (E. I. due Pont de Nemours & Company) and Spergon (United States Rubber Company), have been used.

Preliminary data indicate that the treatments will give increases that will be significantly in favour of the treatments.

Irish potatoes treated with spergon, at the rate of 50 grams of the chemical to a maund of potatoes, gave surprising increases in favour of the treated. The potatoes were treated December 9 and the layout planted the same day. Preliminary data, consisting of seedling counts, indicated that here was a highly significant increase in the number of seedlings in the rows planted to treated potatoes over those planted to the untreated. The yield at harvest time was taken in seers. The decayed tubers were sorted and the weights taken separately. The data are all included in Table No. 4.

TABLE No. IV.

Yield, in seers, of potatoes grown in rows; alternate rows treated with Spergon at the rate of 50 grams of the chemical to a maund of Potatoes.

Row No.	Treated.			Untreated.		
	Sound.	Rotted*	Total	Sound.	Rotted.	Total.
4	140	9	149	..	..	..
5	..	..	..	109	7	116
6	132	7	139	..	..	..
7	..	..	..	105	10	115
8	136	10	146	..	..	..
9	..	..	..	97	9	106
10	148	14	162	..	..	..
11	..	..	..	96	5	101
12	131	7	138	..	..	..
13	..	..	..	113	8	121
14	144	6	150	..	..	..
15	..	..	..	115	8	123
16	129	6	135	..	..	..
17	..	..	..	96	10	106
18	115	13	128	..	..	..
19	..	..	..	97	15	112
20	116	16	132	..	..	..
21	..	..	..	92	15	107
22	126	10	136	..	..	..
23	..	..	..	87	8	95
Totals ..	1317	98	1415	1007	95	1102

When the data is analysed by Students' Method it is found to be highly significant in favour of the treated. It is planned to conduct a more comprehensive set of experiments this coming season before any recommendations are made.

ENTOMOLOGY

In the absence of Mr. W. K. Wesley, Entomologist on leave, the report of that section will be made as a part of the Botany section's report.

*Total per cent of rotted potatoes at harvest time. Treated 6·92. Untreated 8·62. Difference between the treated and untreated total yield, 313 seers. Increase in per cent over the untreated 28·46.

Insect Control in Stored Grain.

In co-operation with the Agronomy Department and the Farm, a series of experiments were conducted to determine the value of D. D. T. and a more recent insecticide known under the trade name as "Gammexane". The D. D. T. was supplied by the United States Rubber Company, Naugatuck, Connecticut. The Gammexane was supplied by the Imperial Chemical Company Ltd., Calcutta. The Gammexane is the gamma isomer of Benzene hexachloride, which has been called gamma 1,2,3,4,5,6, hexachlorocyclohexane.

The D. D. T. was in a wettable form known as M-9008 containing 25 per cent of active ingredient in pyrophyllite. When used for mosquitoes and flies a 5 per cent, by weight, of the M-9008 powder in flit gave excellent results. It had the knock-down effect and the residual effect as well. It was partially effective against cockroaches but did not last long.

A grain *godam* which was heavily infested with weevils (*Sitophylus* sp.) was sprayed with a solution of the D.D.T.-flit mixture with success. The greatest difficulty was getting the spray where it was needed most as only a hand sprayer was available. It did not prove effective, within the limits of the trials here, when used against the grain moth, (Angoumois grain moth, *Sititroga cerealella* Olivier) nor did it appear effective against the flour beetle (*Tribolium castaneum* M.).

Gammexane was used in two forms. D 919 which contains 10 per cent of the gamma isomer and D 025, which is a diluted form of D 919, containing some 5 per cent of the gamma isomer. These were used in the proportions of one part to 100 parts of talc or French chalk. For experimental work the D 919 was diluted at the same rate as D 025, making it twice the strength. However, when used at one part to 200 of talc it was equally effective with the D 025 so that when used it is safe to use the 1 : 100 dilution of D 025 or its equivalent of D 919.

Bagged *juar* seed stored in a *godam* was found to be heavily infested with weevils. D 919 was dusted heavily over the outside of the bags of grain and on walls and floor of the *godam*. Weevils on the bags and on walls and floor were killed in a matter of 24 to 36 hours, but those within the bags were still alive. The grain was then poured out of the bags and the dust thoroughly mixed with it and, after rebagging, was put back into the *godam*. At the time of planting in June no living weevils could be found.

A bin of cow peas were found to be filled with weevils (*Bruchus chinensis*) Using D 919 at the rate of 1:100 of talc and dusting at the rate of ½ pound of the mixture to 40 square feet of surface, all of the weevils were dead within a matter of 36 hours. That meant the weevils within the grains as well as those on the outside.

Within the *godam* where the two treatments were applied, to which reference has just been made, were a total of 7 bins varying from 300 to 600 cu. ft. capacity. Weevils of both *Sitophylus* and *Bruchus* species were found in abundance. After thorough treatment with the gammexane dust the destruction was practically 100 per cent. The destruction of the insects being in direct proportion to the thoroughness of the work.

Field trials with both D. D. T. and Gammexane for the control of such insects as spotted potato beetle (Monolepta signata), larvae of certain butterflies and leaf hoppers, was not apparently effective. Further trials along this line will be conducted during the coming season to determine whether season, age of insect, rate of application, etc., may have been a factor.

Laboratory trials with D. D. T., and Gammexane on various seeds to determine the effect of treatment for control of insects on vitality of the seeds indicated

that there was no reduction in vitality as a result of the treatment. The time between the first germinations tests and the second being about two months.

Selective Weed Killer.

The Imperial Chemical Industries Ltd., Calcutta, kindly sent a sample of a selective weed killer which is manufactured under the trade name "Methoxone". This is an acetic acid derrivitive and is recommended for use against some of the dicotlyedon weeds which grow in the fields. It does not harm cereals. Preliminary trials have not shown it to be effective in the control of any of the weeds in this area.

Cascade Seed Dresser.

The Imperial Chemical Industries Ltd., Calcutta, also sent us for trial, a simple type of seed dresser, which is sold under the trade name of "Cascade Seed Dresser." This is a cylindrical type, capable of handling about ½ maund of grain at one time. By means of a funnel at the top, with an inverted, perforated cone just beneath and another funnel at the bottom, the seed is caused to turn direction three times while flowing, under the force of gravity from the top, until it goes out into a sack. By mixing the chemical seed treatment with the grain as it is poured into the hopper at the top, it is possible to secure a good coating of the seed with from 2 to 3 passages through the dresser. Some 1,500 pounds of jour seed were treated with Arasan by use of the dresser in one half day. For ordinary use the dresser is a simple and efficient machine.

References.

1. Chowdhury, S. A. Leaf Spot of *Carica papaya* L. caused by a new species of *Phyllosticta*. Indian Journal of Agricultural Science Vol. XIV, pp. 395-398, 1944.
2. Vestal, E. F. Notes on Fungi and Weather at Allahabad, Allahabad Farmer, Vol. XX, pp. 12-18, 1946.

REPORT OF THE DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING, 1945-46.

By

T. W. Millen & S. S. Bhatia.

PERSONNEL.

Dr. T. W. Millen	...	Professor of Animal Husbandry and Dairying; Department Head.
Mr. J. N. Warner	...	Associate Professor of Dairying; Dairy Manager.
Mr. N. R. Joshi	...	Associate Professor of Animal Husbandry.
Mr. T. V. R. Iyer	...	Lecturer in Dairying; Acting Dairy Manager.
Mr. S. S. Bhatia	...	General Supervisor in Animal Husbandry.
Mr. P. K. Bhargava	...	Lecturer in Animal Husbandry.
Mr. I. N. Mathur	...	Lecturer in Animal Husbandry special course.
Mr. Qutub-ud-din	...	Lecturer in Animal Husbandry and Dairying.
Mr. G. D. Smith	...	Assistant Lecturer.
Mr. P. C. Thomas	...	Assistant Lecturer.
Mr. K. Das Gupta	...	Dairy Supervisor.

This year a number of changes in personnel took place. Mr. Bhargava was transferred to the A. H. & D. Department from the bullock Research Scheme at the beginning of the year.

Mr. N. R. Joshi who had been a member of our Animal Husbandry staff for about 18 years became Dairy Development Officer for the Central Provinces in June, 1945.

Mr. Warner went on furlongh in July, Mr. Iyer becoming acting Dairy Manager, Mr. Smith joined a post in the Bombay Department of Agriculture in October. His place was taken by Mr. P. C. Thomas who had just been released from a military poultry scheme. Mr. Qutub-ud-din went to Rampur State in November.

Mr. Bhatia became acting Head of the Department on April 1, 1946.

Milk and Milk Products (T. V. R. I.)

The amount of milk and milk products sold for each month of the year are given in Table I.

TABLE I

Sale of milk and milk products from April 1945 to March, 1946

(Figures in pounds and ounces.)

Mouth.	Milk.	Butter.	Dahi.	Cream cheese.	Cream.	Ghee.	Ice cream	Cheddar cheese.	Daily average of milk.
April ..	25749-0	638-6	248-0	..	19-12	..	2468-0	772-1 0	858-4
May .	25628-0	533-10	259-8	0-8	19-8	..	2666-0	340-8	826-11
June ..	21508-8	472-12	273-0	6-0	8-14	39-0	1314-12	496-14	716-14
July ..	26122-8	1552-6	280-8	..	11-16	.	1949 0	376 4	842-10
August ..	28609-0	2327-10	320-0	..	17-8	3-8	1638-12	257-0	922-11
September ..	25783-0	2345-14	211-0	..	44-2	12-14	1712-0	251-14	859-6
October ..	24177-8	2359-6	123-8	..	57-11	29-0	1189-8	82-8	779-14
November ..	28107-0	2651-2	77-0	..	78-2	9-8	596-0	207-5	936 9
December ..	27332-8	2854-6	7-8	3-0	75-6	35 4	60-0	262-6	881 11
January ..	27195-0	2578-8	..		69-12	159-0	12-0	316-10	877-6
February ..	26613-0	2622-6	..	0-8	67-2	34-0	244-0	178-2	950-7
March ..	30947-8	2420-14	111-0	..	84-2	34-12	592-0	299-2	998-4
Total ..	317770-8	23357-4	1911-0	10-0	553-12	356-14	14442-0	3841-3	870-9
Previous year Total.	262775-8	30849-10	2037-14	447-12	392-8	317-4	19565-8	6272-12	719-14

The quantity of milk sold has been steadily increasing during the past three years. An increase of 54,994 pounds was sold this year over last. Daily milk sales were highest in March, as was the case last year, and lowest in June. The present limiting factor for further increased sales is on lack of adequate transportation facilities. Several of our routes are very long and the quantities of milk carried by the salesmen are excessive.

We resumed butter export to Cal cutta in August so the marked increase in butter sales from that month is primarily for this reason. The local demand for butter increased steadily at the beginning of the year, but owing to the decreased consumption of bread after rationing was started, local butter sales decreased. The supply of butter to Calcutta was less than last year resulting in a reduced total butter sale compared to that of the previous year. The Creamery utilized 913 pounds of cream separated from milk produced by our own herd and purchased 31,989 pounds of cream from other sources. Seasonally great difficulty is experienced in securing adequate cream supplies at a reasonable rate.

The amount of cream sold this year was significantly higher than that last year. This increased use of cream possibly is an indirect result of changed diet, again related to rationing.

Less ice cream was sold this year than last. The maximum sale was 2,666 pounds during the month of May. The decreased sale is primarily due to the closing of military canteens which had purchased ice cream from us in large amounts.

There has, however, been an increase in the retail sale of ice cream. We hope to develop our ice cream trade, especially the orders for small quantities, as soon as more equipment becomes available.

This year the amount of Cheddar cheese was restricted in order to meet the demand for whole milk. Most of the cheese manufactured was made during the peak season from surplus milk. There was also a decreased demand owing to large amounts of imported cheese appearing on the market from time to time. Although the sale of cheese was much less than the previous year, it is approximately the same as that two years ago.

MILKING STOCK.

A record number of Female Young Stock was taken into the milking herd during the past year. A number of these 67 heifers are superior dairy animals. The milk yield hit a new peak. The strength of the milking herd was 184 on April 1st. This number includes twelve Red Sindhi cows purchased from Karachi in February. Table II shows the breed-wise distribution of our milking herd. We are using only pure bred Red Sindhi and pure bred Jersey sires so the other breeds are being gradually eliminated.

TABLE II.

Milking stock.

Serial No.	Breed.	Number on 1st April, 1945	Transferred from female Young Stock.	Purchased.	Sold.	Died.	Number on 1st April, 1946.
1	Red Sindhi ..	37	8	12	9	1	47
2	15/16 Sindhi ..	1	3	..	..	..	4
3	7/8 Sindhi-Jersey ..	5	7	..	2	..	10
4	1/4 Jersey-Sindhi ..	33	12	..	14	1	30
5	1/2 Jersey-Sindhi ..	17	2	..	2	..	17
6	5/8 Jersey-Sindhi ..	..	1	..	..	..	1
7	Jersey	2	1	..	..	..	3
8	1/8 Holstein-Sindhi ..	6	3	..	1	1	7
9	3/16 Holstein-Sindhi ..	1	..	..	..	..	1
10	1/4 Holstein-Sindhi ..	3	..	..	3	..	..
11	1/8 Brownswiss-Sindhi ..	2	7	..	..	..	9
12	1/4 Brownswiss-Sindhi ..	9	1	..	3	..	7
13	1/8 Guernsey-Sindhi ..	2	..	..	..	..	2
14	1/4 Guernsey-Sindhi ..	2	..	..	1	1	..
15	7/8 Sindhi-Mixed ..	..	1	..	..	..	1
16	3/4 Sindhi-Mixed ..	5	8	..	2	..	11
17	1/2 Sindhi-Mixed ..	7	1	..	1	1	6
18	Miscellaneous ..	2	..	..	..	..	2
19	Murrah-Bufial ..	22	12	..	8	..	26
	Total	156	67	12	46	5	184

Table III shows the lactation averages for those cows completing their lactations during the year. This year 40 heifers out of the total of 104 cows completed their first lactations, whereas only 16 first lactation heifers were among the 91 in last year's list. There is a general upward trand in the production of all the groups owing to our ability to cull rigorously and to use herd sires that produce daughters as good as or better than their dams. The ½ and ¼ Jerseys taken together give us 39 cows averaging 4283-3 pounds of milk in an average lactation period of 358-8 days with an average dry period of 65-9 days. The original Red Sindhi stock from which they have descended averaged only 1900 pounds of milk and had a much longer calving interval. These cross-bred animals are the most economical producers in our herd.

TABLE III.

Lactations completed during the year 1944-45.

Breed	No. of lactation completed	Average yield in lbs.	Average days in milk	Average days dry preceding	Daily average during milking	Over all daily average period	No. on 1st lactation heifers.
Red Sindhi ..	18	3005·6	308	214·8	9·7	5·7	4
1/16 Jersey-Sindhi ..	1	6580·4	450	..	13·9	..	1
1/8 „ ..	5	2107·0	279	..	7·7	..	5
1/4 „ ..	25	3795·6	334	73·5	11·3	9·3	15
1/2 „ ..	14	5160·6	377·8	60·4	13·6	11·7	1
Jersey ..	1	3794·2	332	60·0	11·2	9·5	..
1/8 Holstein-Sindhi ..	3	3201·8	410·3	..	7·8	..	3
3/16 „ ..	1	3507·6	356	..	9·8	..	1
1/4 „ ..	3	4978·6	396	126	12·5	9·5	2
3/8 „ ..	1	6930·1	374	71	18·5	15·5	..
1/4 Brownswiss-Sindhi ..	6	4540·3	419·1	144	10·8	8·0	..
1/2 „ ..	1	6737·0	324	69	20·8	17·1	..
1/8 Guernsey-Sindhi	2	3653·4	349·5	..	10·4	..	2
1/4 „ .	2	3860·2	286	100	23·9	17·7	1
3/4 Sindhi-Misc. ..	4	3872·1	382	16	10·1	9·7	3
1/2 „ ..	2	6738·6	542·5	70	12·4	11·0	..
Murrah-Buffalo ..	15	4152·0	414	162·6	10·0	7·2	2

Table IV shows the comparative strength and production of our dairy herd during the last six years. We feel that an average of 1500 pounds of milk per day is about the optimum figure for our dairy. We almost achieved this amount as our daily average in the year under report was 1428 pounds. Eighty-seven per cent of this milk was sold to the Creamery as we used a minimum amount of whole milk for calf feeding. During the year 4,56,727 pounds of milk were supplied to the Creamery along with 3845·2 pounds of cream. The cream was from milk separated for calf feeding. In addition to the milk and cream we sold 46 cows and buffaloes at a profit of Rs. 9,960-14-6 over their inventory value. The past two years the sale of dairy cows has contributed materially to the profits of the Department.

TABLE IV.

The Dairy Herd and its Production since 1940.

April 1st	Cows	Buffaloes	Total	Female young stock	Total female stock
1940	103	25	128	116	244
1941	121	28	149	136	285
1942	125	32	157	151	308
1943	144	38	182	167	349
1944	149	37	186	205	391
1945	133	22	155	188	343
1946	158	26	184	173	357

Year	Annual milk production in lbs.	Daily average in pounds	Milk stock diet.	Milk stock sold	Addition from Female Young Stock.
1940-41	4,58,583·3	1256·3	4	12	37
1941-42	4,66,692·3	1278 6	7	12	41
1942-43	4,14,171·8	1134·7	3	19	43
1943-44	4,28,927·0	1175·1	2	17	22
1944-45	4,68,245·6	1282·8	5	74	48
1945-46	5,21,204·1	1428 0	4	45	67

TABLE V.

The Average age, weight and height at withers at first calving of 67 *heifers transferred to milch stock during the year*, 1945-46, (*April* 1944, *March* 1945).

Serial No.	Breed	No. of animals	Average age in year	Average weight in lbs.	Height at withers in inches.
1	Red Sindhi	8	3·61	580·12	44·32
2	15/16 Sindhi	3	3·16	607·00	44·3
3	1/8 Jersey-Sindhi	7	3·25	532·14	46·3
4	1/4 „	12	3·68	612·40	46·2
5	1/2 „	2	2·18	510 5	47·2
6	5/8 „	1	2·12	522·0	43·7
7	Jersey	1	2·35	473·00	39·0
8	1/8 Holstein-Sindhi ..	3	3·88	590 3	43·53
9	1/8 Brown Swiss-Sindhi ..	7	3·76	625·4	47·3
10	1/4 „	1	3·75	675·00	45·31
11	7/8 Sindhi Mixed ..	1	3·05	515·00	41·6
12	3/4 „	8	3·94	581·82	45 6
13	1/2 „	1	4·00	631·83	44·6
14	Murrah Buffalo	12	3·97	986·6	52 4

Four Daughters of our Jersey bull M2 are listed under Jersey, Jersey-Sindhi and 5/8 Jersey-Sindhi. He is the second pure bred Jersey that has sired heifers in our herd that freshened at about 2 years of age. The Red Sindhi average is 3·61 years this year and was 3·55 years for heifers freshening last year. The crossbred Jersey heifers are larger than Red Sindhi heifers of the same age but are smaller than Red Sindhi heifers at calving time. They, however, keep on growing until both groups have approximately the same mature weight.

Table VI shows the breed-wise distribution of our Female Young Stock. We are now using hormone treatment on those heifers showing slow maturity. We have used our Jersey bull M2 on a number of cows already containing Jersey blood and now have a number of fine heifers with 5/8ths, 9/16ths and 3/4 Jersey blood. In general they resemble the Jersey in appearance and early maturity.

Of the 148 bovine heifers 125 are 3/4th or more Red Sindhi and 18 are 1/2 or more Jersey. We plan to continue to grade up one small section of the herd to the Jersey and the major part of the herd to the Red Sindhi.

Table VI.

Female Young Stock.

Serial No.	Breed.	Total strength on 1st April, 1945.	Born, during the years.	Transferred to Milch stock.	Sold.	Died.	Total, strength on 31st March 1946.
1	Red Sindhi	31	15*	8	3	6	30
2	31/32 Sindhi	..	1	..	..	..	1
3	15/16 Sindhi .. .	16	13	3	1	5	20
4	1/8 Jersey-Sindhi.. ..	25	7	7	..	..	25
5	1/4 Jersey-Sindhi.. ..	24	1	12	..	..	13
6	1/2 Jersey-Sindhi ..	4	..	2	..	..	2
7	5/8 Jersey-Sindhi.. ..	1	5	1	..	..	5
8	9/16 Jersey-Sindhi ..	2	2	..	..	..	4
9	3/4 Jersey-Sindhi.. ..	..	6	..	..	..	6
10	Jersey	2	1	1	..	1	1
11	1/8 Holstein-Sindhi ..	7	1	3	..	..	5
12	1/8 Brownswiss-Sindhi ..	18	4	7	..	1	14
13	1/4 Brownswiss-Sindhi ..	6	..	1	..	..	5
14	1/8 Guernsey-Sindhi ..	..	1	..	..	..	1
15	7/8 Sindhi-Mixed	5	6	1	..	1	9
16	3/4 Sindhi-Mixed ..	9	2	8	..	1	2
17	1/2 Sindhi-Mixed ..	4	..	1	..	..	3
18	Miscellaneous	2	1	..	..	1	2
19	Murrah Buffaloes.. ..	33	11	12	..	7	25
	Total .	189	77	67	3	23	173

Male Young Stock.

During the last three years we have been saving a large number of male calves. The Red Sindhi males have gone to the U. P. Government for their Stud Bull Scheme and the cross-breds have been raised for work animals. In this report we are including one table. No. VII, to give some idea of the number of male calves born during the year and their disposal. We are offering a number of 3/4 and 5/8 Jersey bull calves for sale to those who wish to improve the dairy qualities of inferior stock.

*3 Purchased.

TABLE VII.

Male Young Stock.

Serial No.	Breed.	Total, strength on 1st April, 1945.	Born during the year.	Sold.	Died.	Total, strength on 31st March, 1946.
1	Red Sindhi	10	23*	11	4	18
2	31/32 Sindhi	1	1	2	..	..
3	15/16 Sindhi	4	6	3	2	5
4	7/8 Sindhi-Jersey ..	10	5	11	1	3
5	1/4 Jersey-Sindhi ..	4	..	3	..	1
6	1/2 Jersey-Sindhi ..	2	..	2	..	..
7	5/8 Jersey-Sindhi ..	2	8	1	2	7
8	9/16 Jersey-Sindhi ..	1	1	1	..	1
9	3/4 Jersey-Sindhi ..	..	7	..	1	6
10	Jersey	..	1	..	1*	..
11	1/8 Holstein-Sindhi	..	1	..	..	1
12	3/16 Holstein-Sindhi ..	1	..	1	..	..
13	1/8 Brownswiss-Sindhi ..	2	3	2	2	1
14	1/4 Brownswiss Sindhi ..	..	1	..	..	1
15	1/8 Guernsey-Sindhi ..	1	..	1	..	..
16	7/8 Sindhi-Misc.	..	4	..	1	3
17	3/4 Sindhi-Misc.	..	1	..	..	1
18	1/2 Sindhi-Misc	..	1	..	1	..
19	Miscellaneous	2	4	2	1	3
20	Murrah-Buffalo	4	9	3	4	6
	Total ..	44	76	43	20	57

Belgonia Goldfinder.

On September 8th we received a two year old Jersey bull from the Belgonia herd, Victoria, Australia. This herd averaged 503 lbs of butterfat in 273 days leading the next competitor by 34 lbs in last year's standard Herd Test in Victoria, Goldfinder's dam, Belgonia Junette 15th, was the leading two-year old yielding 571 pounds of butterfat. His maternal Grand-dam, Belgonia Junette 5th, has a seven year average yield of 571 lbs of butterfat and leads the Jersey section of the Victoria Standard Herd Test. His father is Aim High and his maternal grandfather, Baron Design, who as an 8 year old recently sold at auction in Victoria for 1600 guineas. This is four times the previous record price for a Jersey bull there. We have spent Rs. 5,000 for Goldfinder but expect to receive dividends when his daughters send maunds of golden cream to our dairy.

Artificial Insemination.

Two short courses in artificial insemination were conducted during the year. The students were primarily veterinarians from some of the Indian States.

About one-third of the outside cows impregnated by our bulls were inseminated artificially. Sixty-two were bred directly and 30 inseminated artificially. In our Institute herd 233 direct services and 140 artificial inseminations were performed. Of the 146 calves born during the year 14 were test-tube calves being the total number of test-tube calves born at the Institute since our first born on 16th August, 1941 to 129 of which 114 are cow calves and 15 are buffalo

*Eight purchased.
(*) Destroyed.

Eggs.

In all 11,476 eggs were produced during the year. Of these 3,830 were used for incubation and 1,609 were sold to the public for hatching. The rest were sold for table purpose.

Sale of Stock.

In all 100 birds were sold for breeding and 107 for table purpose.

Equipment.

We secured two new electric incubators from the workshop and also several new brooders were made.

TABLE XII.

Poultry.

Stock of Poultry on Hand in the Beginning of the year 1945-46.

	White Leghorn.		Rhode Island Red.		Silky		Ducks.		Turkey.		Geese.		G. Fowls.		Capons.	Chickens	Ducklings	Total.
	Female.	Male.	Female	Male.	Female.	Male.	Female	Male.	Female.	Male.	Female.	Male.	Female.	Male				
On 1st April, 1945.	96	20	30	5	12	2	71	32	2	1	3	1	4	3	3	373	96	754
On 31st March, 1946.	133	40	12	8	Chickens 21		28	42	17	17	5	2	14	6	4	288	42	679

RABBITS.

Owing to the need for an experimental animal to determine the cause of sudden deaths in our livestock ; the requests from military units for information on rabbit farming; and the scarcity of meat we started a small rabbitry. We are using all metal self cleaning hutches made at the workshop. The rabbits proved so popular that we secured improved stock of two breeds. On 1st April, 1946, our stock consisted of the following :

Breed	Male	Female
New Zealand Red	1	1
1/2 N. Z. R.	5	3
3/4 Belgian Hare	2	2
1/2 Belgian Hare	1	2
Desi	...	2
Total ...	9	10

During the year 3 rabbits were sold and 1 was used in a diagnostic test. Wolves killed our pure bred Belgian male.

BLOOD MEAL.

We took the total production of blood from the local slaughter house for the ten months excluding the monsoon months of July and August. The dried cooked blood weighed 18,782 pounds. This is 4854·3 pounds less than was produced last year and shows the relative scarcity of animals for slaughter. Our increased poultry and swine enterprise and the fact that we raised all vigorous male calves for breeding or draft purposes kept our blood meal consumption at a maximum. We had 80 maunds of dried blood meal at the beginning of the year but at the close most of this was finished and we were hardly able to produce the blood meal as fast as it was fed. The approximate consumption was as follows :

Poultry	...	...	...	3,964 lbs.
Swine	...	...	...	12,860 lbs.
Calves	...	...	...	7,370 lbs.
		Total	...	24,194 lbs.

GAMMEXANE.

The Imperial Chemical Industries (India) Ltd., sent us a sample of their new insecticide 666, later named "Gammexane."

The gamma isomer of Benzene Hexachloride is the one that attacks insect life most vigorously. Our first experiments were with the crude drug. We had been unable to secure Iodoform for some time for making up screw-worm killer so our first use of the new drug was to combat this scourge of livestock in India. We used the drug in a solution of 10% Kerosene in till oil. The crude drug was only partially soluble and our 10% suspension was more concentrated than necessary, but we were pleased with the results. The larva were killed on contact and flies of all kinds were repelled from the wound for some time. Wounds healed very rapidly.

We found that the mixture was also effective against dog ticks and mange mites.

Later when the 5 % mixture of powdered Gammexane in talc became available we tried it. We also used more dilute suspensions. We now use 5 % of this powder "D. 025" either in till oil or in lard depending on whether we want a liquid suspension or an ointment. We find this method of application both expensive and effective.

All type of Calliphorinae are killed by the Gammexane. We have killed them on horses, cows, buffaloes, donkeys, swine, sheep, goats and poultry. The iodoform mixture we had been using previously was very toxic for suckling pigs, resulting in the death of whole litters of treated sows. The Gammexane mixture is not dangerous in this way. We have used it in the eye of swine where screw-worms were present. Also we have dusted pure D.025 on wounds and on the screw worm infected tongue of a dog. In both cases the larvae were quickly killed and healing was rapid. No toxic effects or pain due to the drug were noted.

We have killed mange on calves, swine and dogs and ticks on dogs, cattle and goats with the oil suspension or the lard mixture. Two or three applications intervals of two or three days are usually sufficient.

The pure D.025 powder in ant traps protects our bees from all crawlir intruders and should be effective against poultry ticks.

REPORT OF THE CHEMISTRY DEPARTMENT, 1945-46.

By

A. P. Brooks.

Staff.

During the year under report the staff remained much the same as in the previous year :—Mr. A. P. Brooks, Head of the Department, Messrs C. O. Das and J. C. Gideon, teachers. Dr. B. B. Malvea, Principal of the Ewing Christian College, continued to teach B. Sc. classes in theoretical agricultural chemistry. Mr. Brooks, who had been giving much time as acting Treasurer, was relieved of those duties and reverted to full time in Chemistry.

Supplies.

The supply situation improved somewhat during the year, particularly with regard to materials used in routine experiments in Intermediate classes. Some experiments in B. Sc. classes could not yet be resumed due to difficulty of procuring a few chemicals or equipment. The most encouraging thing during the year under review was the probable availability of considerable amounts of both chemicals and glassware from American Army Surplus Stores. Orders were placed for considerable stocks, which in fact were actually, to a large extent, procured in the following year.

Activities

As usual, most of the work of the department is routine teaching, both theoretical and practical. This takes most of the time of the staff so that there is little left for research or experiment. However, the department is called upon by other departments either to undertake various investigations or to test the purity of supplies. Milk and dairy products are frequently examined for purity. Feeding materials were examined for suitability for livestock feed. Oil cakes were tested for nitrogen content.

Supplies of condemned *a'a* and *maida* purchased from the army were tested before feeding to dairy animals. One lot of several tons of biscuits, rejected by the army, was tested and found both suitable and economical as a concentrate food for milch cows.

"The earth is the mother of us all-plants, animals, and men. The phosphorus and calcium of the earth build our skeletons and nervous systems. Everything else our bodies need except air and sun comes from the earth."

—Henry A. Wallace.

REPORT OF THE DEPARTMENT OF AGRICULTURAL ECONOMICS, 1945-46.

By

H. S. Azariah.

Head of the Department.

During the year under report changes took place in the staff. The Biology Department wanted the full time services of Mr. L. O. Nott. When an attempt to secure an assistant was unsuccessful, Miss. S. Riker, the Institute Treasurer, kindly consented to help us out. We are indebted to her for this timely help.

As usual, most of the work done by the department is routine teaching. Miss Riker took one period a week of economics with the first year men, and three periods a week of book-keeping with the Indian Dairy Diploma class. The, department of Home Economics made its own arrangemnt for the first year girls-but the teaching of the principles of Economics to the second year girls was con tinued by this Department.

The department was *un-officially* connected with the establishment and operating of a consumer co-operative store at the Institute. It has given the department a first hand knowledge of the working of the co-operative societies in India. Miss Riker's experience in the United States and in Japan was most useful for comparing this one with similar societies in those countries. It is a well known fact that the co-operative idea in India is not the result of popular demand of the people, but the effort of the Government, which was superimposed from above. In actual practice, the differences are conspicuous: it works within a very narrow limits of Governmental Rules and regulations with very little freedom for individual initiative. One gets an impression that the petty officials are more particular to satisfy the orders, rules and regulations of their superior officers than to help build sound Co-operative Societies. With popular government and with enthusiastic superior officials this danger is just as great. Co-operatives in the United States are organized on a strictly business basis; whereas in India by depending on rich and influential men to be sponsers and even office bearers, the Co-operative societies have been made into philanthropic organizations.

With inadequate staff, again no research project could be undertaken. Last year's report of the department on this subject brought a few letters from the alumni who were willing to co-operate with the department on any project it might put forth. That was most encouraging. A few price and other charts were made and some of these were exhibited at the Farmer's Fair. As indicated last year, the urgent need is to *analyse available data* and to prepare charts and tables suitable for teaching. Such projects involve determining averages, indices, co-efficients of correlation and like. This sort of work must necessarily be slow without proper equipment and facilities. Our experience has strengthened the statement we made in our report of 1942 :—"A great deal needs to be done in this field.....Most of the work involved in the statistical analysis of factual data cannot be done efficiently without a calculating machine."

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Printer—The Mission Press, Allahabad, U.P.

Published by :—The Allahabad Agricultural Institute, Allahabad, U.P. (India)

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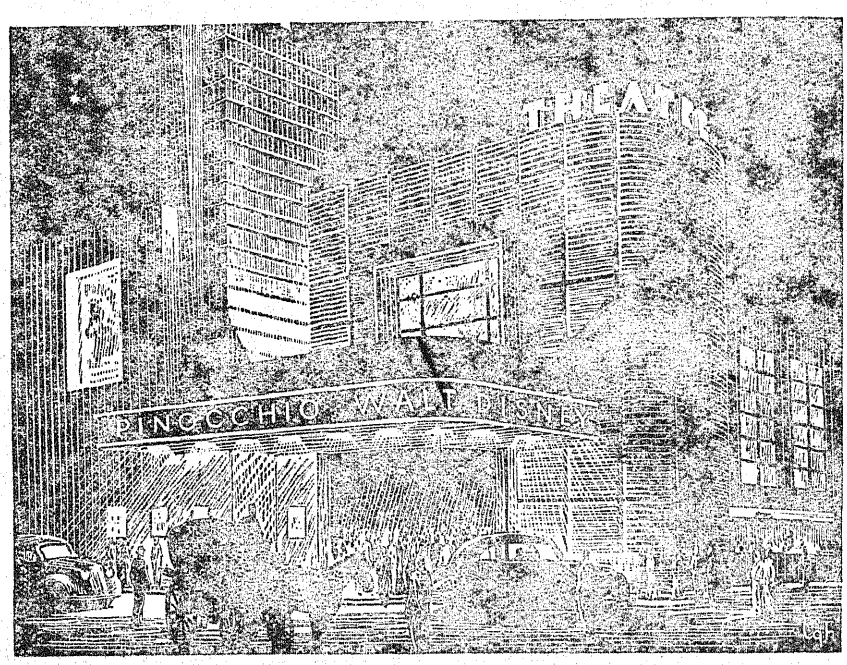

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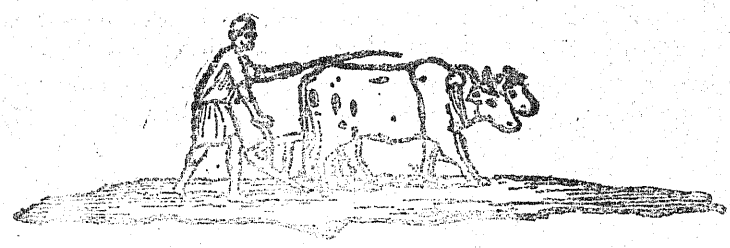

VOL. XX] SEPTEMBER, 1946 [No. 5

Editorial

Growing Profits and Perils

The importance of fruit as a contribution to the welfare of the country is increasingly recognized, and it is also increasingly clear that fruit growing is one of the few parts of agriculture in which the farmer can hope for a very satisfactory profit. In fact, the profit is frequently larger than is desirable. The prices paid per acre of mandarin oranges near Nagpur are recognized as being high, and it is sometimes said that this is explained by the limited area of suitable soil. But when the crop of one acre of this fruit, on rather ordinary soil in the United Provinces, at a considerable distance from either railway station or good road, sells to a contractor for Rs. 1,600, some other explanation must be sought At another place in the countryside of the U. P., a progressive zemindar has found over the years that the planting of orchards has been the most profitable investment for his mony. It is obvious that there is both need and demand for a much larger acreage of fruit.

Acreage in different parts of the country is increasing, although, unfortunately, there are still no statistics regarding the acreage in some provinces This increase needs to be accelerated in many areas, and as production catches up with the demand, the efficiency of the grower must be increased to allow him to produce at the lower prices which will result and which are so desirable from the point of view of the average consumer. Lessening the risks involved will not only favour increased acreage, but will help protect the farmer when lower prices come.

Among the most urgent needs of the fruit farmer is the need for better protection against the pests and diseases which attack his crops. While there is need for more investigation of insect pests and their control, a number of entomologists are attacking these problems. Diseases are still, to a large extent, neglected, and it is becoming clear that their control is a matter of extreme urgency if the industry is to develop as it should. Perhaps nothing else stands in the way of the growth of fruit growing to the same extent as does this problem of disease. This may be illustrated by some instances around Allahabad.

The most important fruit of this district is the guava, a hardy tree which bears large crops with comparatively little attention. For some time a wilt disease has been killing the trees in the area west of the city reputed to grow the finest guavas. More recently, it started in the orchards near the Institute, and

has spread gradually, killing two or three dozen trees each year. This year it has appeared here and there in this entire section, killing hundreds of trees. Unless something can be done, this area will be like the one west of the city where, when it was pointed out that young trees were planted very close together, the reply was that even a small amount of space was enough because the trees died so soon. A species of the fungus *Cephalosporium* has been isolated from the wood just beneath the bark, which may be assumed to be the causative agent, but nothing is known about how it is spread or how it can be controlled.

The papaya produces an enormous yield of excellent fruit and is one of the most profitable crops to grow at Allahabad. Three acres at the Institute were sold to a contractor this year for Rs. 11,350. The crop is very easily grown and produces a crop in less than two years from sowing the seed. Yet the acreage seems to remain about the same or perhaps decrease. Some years ago there were papayas on the municipal sullage farm; now there are none. The prevalence of disease may be the explanation. Stem rot, caused by a species of *Pythium*, and anthracnose are diseases which have been studied and against which some measures are known, although satisfactory control has not yet been achieved. In addition there are several fungi causing root rot, about which very little is known. In a healthy orchard fair crops can be expected for three years, whereas if these diseases are present, the stand by the second year is greatly decreased, and it is not likely to be profitable to keep the orchard for more than two crops. The loss from even a few acres would finance a considerable programme of research on the diseases.

These are but examples of the diseases which cause a tremendous financial loss, and a large decrease in the already sadly inadequate fruit supply of the country. May it not be hoped that with the co-operation of the scientists in the universities and research institutions, satisfactory methods of controlling these diseases will be found within the next few years? Many fruit growers will be profoundly grateful tothose who free them from the constant threat of ruin which now hangs over them.

W. B. Hayes.

A farmer once took me over a broken fence through weeds and brush to a tree that showed at its base a large crown-gall, a disease that has had most interesting study, but he thought a neighbour who didn't like him had slipped in at night and poured something around his tree.

Compare such a misguided and suspicious life with that of a man who is alert to all that is learned about his trees and their environment, uses all that can be applied but when full truth suggests that there is no remedy for some of his difficulties accepts the situation with shoulders back and eyes straight ahead. Thousands of men like this are managing orchards in different parts of the world, and even a great eucalyptus tree against a California sky is not as beautiful as such study character against a growing light of truth.

William H. Chandler (Horticulturist in the Experiment Station, University of California, Loss Angeles) in a talk given at a Citrus Institute and reported in the California Citrograph 31 : 209 ff. June, 1946.

AGRICULTURAL ENGINEERING : A CAREER FOR CAPABLE YOUNG MEN.

By

V. B. Rasal.

What is Engineering ?

The accepted, formal definition of engineering is "the science of utilizing the forces and materials of nature for the benefit of man, and the art of organizing and directing human activities in connection therewith.

What is Agricultural Engineering ?

Though agriculture is the oldest of the industries, agricultural engineering is one of the later branches of engineering to be recognised as such. In theory at least, agricultural engineering began at least as long ago as the first crude plow with which primitive man tried to till a seed bed. But it remained for the newer states of a young nation to give it a name and a place in their educational system.

Agricultural engineering has not burst into being with the mushroom growth attending such innovations as radio or aviation, it has grown steadily, consistently, and rather rapidly. At the present time its growth is at a faster pace. The qualified agricultural engineers are briskly in demand, and the prestige of agricultural engineering in public and private esteem is high and going higher.

The first degree of "Bachelor of Science in Agricultural Engineering" was conferred in 1910. By 1922 seven institutions were offering such training ; in 1925 ten ; in 1929 seventeen ; 1931 twenty. Now more than half (27) of all the states in U. S. A. by their land-grant colleges and universities, give instruction leading to the bachelor's degree in agricultural engineering or its equivalent.

At What do Agricultural Engineers Work ?

In practical farming, crop-growing, animal feeding and return of fertilizer to the soil all are parts of a single working plan, though they may be studied more or less separately. So agricultural engineering is a single profession, its parts bound together and inter-locked because all apply to a single industry and single farms. But it helps in getting an orderly picture of the things that these engineers do, to look at them classified according to the technical divisions which the American Society of Agricultural Engineers has set up as a means for specialized study in meetings and to divide the work of technical committees.

Farm Power and Machinery :

Power means any and all kinds of energy used instead of human muscles. It even includes horses and mules as they are used as sources of energy. Tractors, of course, are a major subject, but also included are power from steam, wind, water or any source of energy as they may be used in agriculture. Because they are so closely bound together in practice, power is grouped with machinery.

Machinery is the means of applying power. In a general way it means the products of the farm equipment industry. It includes the plows, harrows, cultivators, etc., for tilling the soil, the drills and seeders for planting. It means all manner of haying machinery-mowers, rakes, loaders, balers, choppers. It embraces the machinery of harvesting and threshing all manner of grains and seeds. It involves processing machines such as the ensilage cutter, feed grinder, cotton gin and many others.

Farm Structures:

It is most important to remember this phase of agricultural engineering, for farm structures are largely left out of the activity of the consulting architect in private practice. By making fruits of their research, embodied into practical plans, available to many farmers, farm structures engineers give to each farmer a degree of expert skill and exhaustive care with detail that would be economically impossible for him otherwise to enjoy. The farm architect correlates his work with the machinery to be used and with refrigeration, heating, water supply, etc., with which other agricultural engineers are jointly concerned.

Normally, about 60 per cent. of America's construction is on its farms. No other service to agriculture has so much to do with advancing the standards of living for farm families. As economic adjustment progresses it seems due for immense development with excellent promise for suitably trained architect engineers.

Rural Electrification:

It deals with all uses and applications of electricity in rural, as opposed to city, conditions. It includes residential uses, which may be those of merely suburban dwellers. But the major element in rural electrification—the thing that makes it economic and therefore imparts impetus to it—is the disovery, development and promotion of distinctly agricultural uses for electric energy.

Soil and Water Conservation:

Until recent years this division of agricultural engineering was called "Land reclamation" embracing principally drainage, irrigation, and clearing land of stamps, stones, etc. Now the emphasis is less on the taming of new land and more on the care and improvement of old lands. The national programme of oil erosion control, that seemed to come so suddenly, was made possible by a generation of patient research and development and is based fundamentally on the principles of land drainage as defined by agricultural engineers. Terracing, whether done as federal or state projects or by individual or group enterprise of farmers, is devised, planned, and often directed by agricultural engineers.

Soil and water conservation engineers co-operate with many other agricultural scientists—foresters, agronomists, meteorologists, with power and machinery engineers—to devise suitable terracing machines and ways of tillage that resist the ravages of wind and water. Soil and water conservation is interlocked with flood control, navigation, hydraulic power, wildlife conservation, timber resources. Already the demand for qualified engineers has exceeded the supply, and there will be work for many engineers for many years. In the provinces of Bombay Presidency, Bihar, C. P., and Punjab agricultural engineers are needed very badly for such work.

Who Hires Agricultural Engineers?

In the world to a greater degree than any other branch of engineering agricultural engineers are educators, nearly half of their numbers, as indicated by the membership in the American Society of Agricultural Engineers.

At present in India the number of well qualified agricultural engineers is very small. The qualified degree-holders are mostly government scholars and as such the question of their employment is solved by the government. While of the others, some are in the teaching staff. Some are doing research work under the guidance of Mr. Vaugh and others are working on good salary in Volkart & Co. or William Jacks.

In Industry :

The other great group of agricultural engineers are employed by the industries which serve agriculture, notably the farm equipment industry. But they also work for companies who supply building materials, fencing, etc. These are the men who develop design and improve combines, tructors, terraces, tillage tools, barn equipment, etc.

In Management And Finance :

In foreign countries more and more agricultural engineers are employed by banks, trust companies, insurance companies and all such financial agencies to appraise, rehabilitate, and supervise operation of farm properties which come into their control, often in an insolvent condition, which challenges the genius of the engineer to restore to a paying basis. Canning companie , sugar companies, and other large scale agricultural enterprises employ numbers—now comparatively small, but steadily increasing of agricultural engineers for managers. In India though at present there is at present little scopes for agricultural engineers for the above mentioned works, yet, looking to the progrees of the country we can hope that the field of the agricultural engineers in this country will be extended

How much do Agricultural Engineers Earn?

Aside from the love of one's work, which must be a m jor compensation for most professional men, the agricultural engineer naturally finds himself in a social sphere of intellectually s imulating, congenial men among whom a lavish scale of living is not called for. With a larger degree of security than most occupations, with every worth while care and comfort within his income, usually able to give their children an excellent education, the agricultural engineer can fairly expect a long wholesome, useful and happy life.

Who should enter Agricultural Engineering ?

Some agricultural engineers made swamps in hip boots, and seldom see the bright light of the city. Some work in skyscrapers and seldom set foot on the soil. All, however, must have their interests rooted in farming and in the welfare of farm folks. Added to this must be an instinctive, aptitude for the engineer's way of thinking, his ability to assimilate the love of science and transform it into practical performance.

Because agricultural engineering is many kinds of engineering applied to the broad business of agriculture, you must know what farming "is all about." You need not be a specialist in any other phase of farm science, but you must have a first hand practical knowledge of farm work and farm life.

Agriculture is applied biology. Therefore more than any other sort of engineering, agricultural engineering calls for a broad understanding of biology. If you are to be an agricultural engineer you will need, and sooner or later must get a knowlegdge of plant and animal physiology ranging all the way from bacteria to bees, but with more attention to farm crops and animals.

What about Training for Agricultural Engineering ?

Agricultural Engineering is taught in many colleges of agriculture and engineering in foreign countries. A list of names and addresses of institutions giving instruction leading to the degree of Bachelor of Science in agricultural engineering or its equivalent will be furnished on request to the American Society of Agricultural Engineers.

In this country at present there is only one institution which imparts training for the degree of Bachelor of Science in Agricultural Engineering ; it is situated at Allahabad.

It is helpful to make the acquaintance of practicing agricultural engineers, both to get a more vivid picture of the profession and its work and for assistance in appraising your own fitness for it.

IMPORTANCE OF BERSEEM AND ALLIED CLOVERS IN AGRICULTURE WITH REFERENCE TO U. P. CONDITIONS.

BY

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INTRODUCTION.

Legume forages, and fodders help in the maintenance of the farm if grown in proper rotation. They form an important source of livestock feed because of the presence of high protein content, help to balance the high carbohydrate content of the silage, acting as good soil improvement crops because of their leguminous nature and ability to fix atmospheric nitrogen in the soil, in addition to being cover crops.

Berseems and other clovers being legumes make ideal succulent fodder and forage crops for milch cattle, being in addition soil improving crops.

In India, even at the present time forage crops are grown to a lesser extent; of those growns most of them are deficient in nutrients, the total digestible nutrients being available to an extent of 33% and digestible proteins to an extent of 14·3%, of the required amount needed for cattle.

During winter and dry months, poor quality of fodder is usually available for the feeding of cattle being chiefly straw of cereals, and kadbi, these inadequately supply the maintenance ratio. Of the important fodder and forage legum s lucerne and berseem supply to a large extent the nutrients during the scarcity months, namely, December to June.

The clovers being grown in India, can be grouped into two groups:

1. True clover such as (*i*) Berseem *Trifolium* (*alexandrinum*) or Egyptian clover, (*ii*) Senji (*Melilotus parviflora*) or Indian clover, (*iii*) Shaftal (*Trifolium resupinatum*) or Persian clover.

2. False clovers, *e.g.*, (*i*) Burr, Californian or Toothed clover, (*ii*) Fenugreek (*menthya*) Metha.

Of these Berseem, Senji, and Burr clover are widely grown for forage, fodder, and soil improvement. Senji, and Burr clover grow wild in large areas in Northern India, under favourable conditions, giving a comparatively lower yield of fodder, if cultivated.

Berseem is a cold weather (Rabi) herbaceous annual growing to a height of 1·5 to 2 0 feet. Leaves are palmately trifoliate, leaflets narrow, sessile. Flowers varicoloured usually white. Inflorescence a dense spike. Pods small membranous, one to more seeded, indihiscent, opening circularly. Seeds small and reniform.

Two varieties are commonly grown in India (*i*) *Khadrawi*, and (*ii*) Muscowi (*miscawi*). The latter is said to have orignated from the lower Nile valley, is a more vigorous, taller, higher yield variety than the former.

Berseem is an ideal irrigated fodder crop, being grown on most of the military and other big dairy farms for forage fodder, and silage. It is tolerant to Alkali soils, giving a good yield of green, nutritive, palatible fodder. It can be easily grown in rotation improving the soil. It increases the milk yield and general condition of the cattle, being second to Lucerne as regards the yield of total digestible nutrients and starch per acre.

It grows best in cool dry weather, being adversely affected by extremes of temperature, drought and water logging.

Provided, the tilth is good, a wide range of soils varying from sandy to clayey loams are suitable for growth. Acidic conditions of the soil are deterimental for growth. First irrigation is heavy to delay the second irrigation, the required amount of water is given in moderate doses during the young stage. The irrigations given depend on the type of soil varying from 8-10 in number, on the average. Timely irrigation is necessary, the first is given at sowing time, the

second after 10 days, during winter months an irrigation may be given after three weeks or one month each, while in the warmer months the crop may be irrigated once in 10 days or one week, as may be necessary.

If the crop is to be cut for seed one irrigation is given at flowering time and the other during maturity in addition. In each irrigation about 3" of water is required, and care is taken to see that it is uniformly given.

The nitrogen requirement is 50 lbs. per acre for fodder in U. P., while in Chota Nagpur (Bihar) about 40-50 lbs. is required since the soils are comparatively poorer. In U. P. a moderate application of farm yard manure is given, while in Chota Nagpur the necessary amount is supplied by 1·0 Md. of Niciphos per acre.

Preparation of the field. The main point to be kept in view is that a good tilth is required. Preparation varies under local conditions. Usually, couple of ploughings with a soil turning plough is given, after which three to four cultivations are given with a cultivator, or a spring tooth adjusted to work shallow, this can be followed by couple of plankings or "patella," or one ploughing may be given by a soil turning plough (Victory, Punjab), field planked once, again ploughed by desi plough or harrowed diagonally across, and again planked.

In certain areas Berseem is sown in standing *kharif* crops, *e. g.*, Paddy, or cotton, where these are harvested in October. In this method the labour and cost of preparation of a separate seed bed is saved.

Inoculation. In fields in which Berseem has not been grown before, inoculation should be done to ensure a uniform and good yield of the crop. The following is the usual procedure of Inoculation :—

A solution with one chattak of gur or sugar in one pound (half seer) of water is made, a soil culture is mixed to make a muddy suspension, next enough seed to sow an acre is heaped in a vessel and the suspension well sprinkled, to give a coating. The seed is spread out in thin layers in the shade to dry, before being sown, either by broadcasting or drilling.

Time of Sowing. Usually sown in the *rabi* season in Northern India, anywhere from beginning of September to beginning of December, profitable to sow in October.

Method of Sowing. Differs in Different areas, under the existing conditions, but sown broadcasted or drilled. If sown broadcasted, it may be done by either of the two methods, (*a*) Seed is soaked overnight and next morning the field is irrigated lightly, while there is still some water in the field the soaked seed is broadcasted, (*b*) Soaked seed is broadcasted and immediately covered lightly with the foot, or spike harrow, and irrigated.

In either case a level uniform field is needed as well careful irrigation, to allow a gentle flow of water in the field so as not to disturb the seed giving irregular stand.

When the seed is drilled, flat ridges are made or ridges can be made as usual, and the patella run over them to compact and flatten them so as to enable the drill to move along smoothly.

It is advisable to space the ridges at least 18-24" apart, so as to facilitate bullock power interculture, which is quicker, cheaper, and more efficient than hand weeding as practised in the case of broadcasted seed.

Once the seed is sown on the ridges, the field is irrigated gently so that the water passing through the furrows may be well absorbed by the soil. Seeds germinate in 3-5 days time.

The crop is intercultured from time to time to destroy the weeds, if a cultivator is used than along with the interculture earthing or the ridges is accomplished. Seed rate varies from 12-15 seers per acre for fodder, slightly less being required for seed purpose. Experimental results indicate that 8 seers per acre for fodder and 6 seers per acre for seed are sufficient for U. P. conditions.

Number of Cuttings. Number of cuttings vary depending upon the time sown, the kind of soil, amount of irrigation, and manure given, and the prevailing temperatures. Usually the first cuting is taken after two months of growth or when the plants are 9-12 inches high, while the subsequent cuttings are made after 4-5 weeks.

Generally four to six cuttings are taken between November to April, but with care and watering during summer the growth can be prolonged till the end of May to give another cutting.

Yield :—Yield varies from 90 to 100 maunds of green fodder per cutting per acre, or 360-600 maunds of green fodder per acre per year, in four to six cuttings, maximum being 120 maunds per acre per cutting. If the crop is grown for seed purpose, then cuttings for fodder are not taken after mid February, or after the third cutting, so as to allow flowering, and maturity of seeds. The yield in this case being 100 maunds per cutting per acre of green fodder and 2·5 maunds of seed per acre.

Suitability for Forage and Fodder. *Grazing or Forage* : The animals are allowed to graze in certain places to check the wastage of green fodder, either open, or tethered in rotation to give uniformity. The animals should be grazed on full stomach for 15-20 minutes to avoid indigestion and tympanitis. Continuous rotational grazing appreciably increased the milk yield and general condition of the animals. An average increase of 20·0% or 2·4 lbs of milk per day was observed in a milch herd grazed on Berseem at the Kanke experimental farm.

Grazing or cutting of the crop should be done when the soil is moist, if it is wet, deflocculation, and eventual puddling may be caused if it is dry during the operation new growth will be delayed. 4-5 pounds of green fodder should be given to each animal per day, care being taken to see that the fodder is not wet, so as to aggravate indigestion, etc.

Green fodder with oat straw or green oats makes a good silage in 3 : 1 ratio, 35% of the moisture being lost during ensilaging. Silage made in March will be ready for use in May.

Good quality hay can be prepared if care is taken, some of the nutrients being lost during caring, but the loss can be reduced if care is taken. Leaves contain a higher percentage of Protein and mineral constituents, these can be lost by shattering during curing. The green material should be stored before fully dry, and the cured material should be handled in the morning to avoid greater loss. Green fodder yields 15-20% of hay, by weight.

It has been observed that with the availability of leguminous hay, such as Berseem and Lucern, quite a bit of concentrates from the feed of poor or moderate milkers can be lessened, and a suitable ration with the leguminious hay supplying the protein can be computed. (Sen. 1938).

Soil Improvement :—Experimental results indicated that the increase of nitrogen in the soil after two crops of Berseem was increased by 0·2 per cent in the fields in which the crop was grown, during the latter stages of growth, the nitrogen in the root nodules is utilized by the plant and, consequently, is not available to the soil to any appreciable extent.

Precautions to be followed for growing a crop :—Berseem needs comparatively a large amount of moisture, and a level field with good drainage and aeretion. Water for irrigation should be given from a higher level so as to give a gentle flow, each field as far as possible should have distributory channels thus being independent of other fields as regards drainage, so as to minimize the loss of nutrients and organic matter. Good drainage and aeretion are necessary for a good uniform growth.

Uses of Berseem :—Chiefly used for green fodder, silage, hay, and pastur

SENJI (INDIAN CLOVER) *Meliloturns parviflora*

Yellow sweet clover, plants are herbaceous shrubs growing to a height of 1·5 to 2·0 feet, erect, annual to biennial in nature, having a fragrant smell, thicker leaves Lucerne with bitter taste.

Leaves are pinnately trifoliate, stalked, with marked stipules, dentate leaflets, the viens ending in teeth. Flowers are long, slender, small, one-sided exillary racemes, white, or usually yellow.

Young plants are similar to Lucerne, grown to a large extent in the Punjab and N. W. F. P., growing indigenously as well. If grown three to four cuttings can be taken, the yield per cuttings being lower than that of Berseem per acre.

SHAFTAL (PERSIAN CLOVER) *Trifolium resupinatum* or *T. Suaveojens.*

Resembles Berseem in habit, and external characteristics, but is not as tall or vigorous. If grown as a crop it is broadcasted, usually mixed with other legumes or grown singly. Under irrigated conditions gives a good yield of green fodder. The rate of growth is slower than Berseem, and the yield per acre less comparatively.

BURR CLOVER (*Medicago hispida var denticulata*) TOOTHED OR CALIFORNIAN CLOVER

A hardy semi-erect or prostrate annual found growing wild in U. P., and Punjab, and to some extent in other areas of Northern India. Under favourable conditions of cool dry temperatures, profuse branching from the crown can be observed, branches are decumbent and spreading. Small yellow flowers in clusters of five to ten are present. The pods are coiled, with spines (Burr) and net viened, containing small pale brownish yellow, reniform seeds. Leaves are typical having small witish or dark red spot, scattered on the surface in the young stage.

Usually it is found growing wild, and if present over large areas gives a yield of green fodder or makes a good pasture. It can be grown as a forage crop if the prevalent conditions make it worth while, or be used as a soil renovating crop.

FENUGREEK (*Trigonella foenum-graecum*) METHA.

Herbaceous annual, growing to a height of one to two feet. Several thin circular stems are given out from the crown. Leaves are pinnately trifoliate, petiolate with a couple of light green stipules. Flowers are sessible borne on leaf exils singly, being white or light yellow. Pods are 3-4″ long pointed with a long persistent beak containing 10-20 seeds.

Mostly sown as an irrigated garden crop, for spice potherb, or medicinaluse, and forage in certain areas. Grown largely in the provinces of Madras, Punjab, and U. P., sown broadcasted or drilled, generally as a *Rabi*, or a catch crop in Northern India.

It is a carminative, used for gastric troubles, it also increases the flow of milk, and is used mixed, ground with mash or feed for cattle, as well as a condition powder for livestock.

Generally two varieties are met with (I) tall growing variety, *Metha* grown for green fodder, and (II) small variety *methi* grown as a spice, and potherb.

REFERENCES :

(*i*) Sen, K.C. Nutritive values of Indian cattle foods and the feeding of animals. Miscl. Bull : No. 25. I. C. A. R., 1938.

(*ii*) Pugh, B. M. and C.P. Dutt :—Principles and Practices of Crop Production in India, 1941.

(*iii*) Robbins, W.W. :—Botany of Crop Plants, 1925.

Average of Composition of Indian Feeding Stuffs on dry Matter Basis.

Name	Place of origin	Total ash	Crude protein	Fibre	Nitrogen free extract	Ether extract	Cao	P_2O_5	Mgo	Na_2O	K_2O	Remarks
GREEN FEED												
1. Berseem (*Trifolium alexandrinum*)	Bihar	20.25	15.45	26.06	35.88	2.36	2.33	0.75	0.77	..	4.78	Figures given for comparison of the different plants as their suitability for forage fodder and concentrate
Maximum	Punjab	18.96	23.10	30.87	46.94	2.78	4.05	0.92	0.72	2.58	5.09	
minimum		8.49	13.99	19.47	33.24	1.39	2.20	0.32	0.38	0.36	1.44	
average		14.16	17.35	25.91	40.69	1.89	2.69	0.64	0.61	1.67	3.40	
2. Senji (*Melilotus parviflora*)	„	9.50	15.46	31.62	41.95	1.47	1.89	0.42	0.44	0.34	2.21	
3. Shaftal (*Trifolium resupiratum*)	„	17.66	21.51	16.90	42.02	1.91	2.79	0.76	0.56	0.67	4.87	
HAY												
Berseem	„	12.13	14.70	30.56	40.99	1.62	2.07	0.65	0.61	0.58	3.89	
CONCENTRATES												
Senji pods	„	8.54	25.30	14.85	49.37	1.94	1.87	0.80	0.41	..	2.78	

Nutritive Value of Feed Stuffs.

Name	Place of origin	Digestible nutrients/100 lbs of dry matter						Digestible nutrient per 100 lbs of raw matter	
		Crude protein	Carbohydrate	Ether extract	Total nutrient	Nutritive ration	Starch equivalent	Digestible crude protein	Starch equivalent
GREEN FEED									
Berseem	Bihar	12.56	44.47	1.18	59.68	3.8	43.4	2.51	8.7
	Punjab	14.10	48.23	0.91	64.46	3.6	48.4	2.82	9.7
Senji	„	12.61	50.01	0.63	64.04	4.1	44.7	2.52	8.9
HAY									
Berseem	Lyallpur	10.29	54.44	0.47	65.79	5.4	47.3	9.26	42.6

A SIMPLE METHOD OF MANUFACTURING IODINATED PROTEIN AND EFFECTS OF FEEDING ON MILCH ANIMALS.

By

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It has been demonstrated that by selective breeding productive capacity of domestic animals can be increased. Until recently, the changes in physiologic mechanism which cause this increased productivity have remained unexplored. With the development of endocrinology, it has been found that endocrine glands play an important role in the more direct mediation of productive ability. For example, an animal bred for fast growing capacity may attain the inherited expression because its pituitary has a high secretory activity with respect to the growth-promoting hormone. High milk production is inherited but its expression is integrated with the inheritance of various physiologic mechanisms, one of which is undoubtedly high thyroid activity since thyroxine has been shown to increase milk production

Recent research on the relation of thyroid function to productive ability has been made. There are indications that increased thyroid function increases milk and butterfat production, egg production and stimulated growth in some species. Removal of the thyroid gland from immature animals results in growth stagnation, lowered metabolism, and a general retardation of most of the bodily process and activities Conversely, the administration of thyroid substances causes acceleration of body processes. For more than fifty years dried thyroid gland tissues from domestic animals have been administered orally by clinicians for the treatment of thyroid deficiencies (in man). Since the human requirements are small the cost of mediation has been moderate. However, when W. R. Graham (1934) demonstrated the effectiveness of thyroid gland tissue and thyroxine in stimulating increased milk and fat secretion in dairy cattle, the need of cheaper sources of thyroidally active material became apparent. Practical value of this discovery has been nulified very largely by the exorbitant cost of thyroxine and of dessicated thyroid tissue.

For many years it has been known that when iodine is mixed with protein under certain conditions, it becomes chemically united with the protein and free iodine is no longer present. By experiments it has been proved that protein so treated contains physiological activity comparable to that produced by Thyroxine.

The process of manufacturing thyrolactin or thyroprotein prescribed by Turner and Reinke is not possible for the ordinary dairy man. It can be manufactured only in well equipped laboratories and the whole process takes about three days to complete. No work has been reported in India on Thyroid protein as yet.

In order to investigate the possibility of making a cheap, simply prepared and effective thyroid-like protein for stimulation of milk flow of dairy cattle, a series of experiments have been undertaken at the Allahabad Agricultural Institute. This paper describes the first experiments along this line.

It was decided to try iodinated casein as a thyroprotein. A simple method for its manufacture was worked out. First a stock solution of Iodine solution was prepared in the following proportions :

2.8 grams of Potassium Iodide

1.5 grams of Iodine crystals

75 c.c. water.

A liter or so of this stock solution was made up for use as needed.

The iodized protein was prepared by placing 1000 c.c. of fresh separated milk in a tinned brass *dekchi*. Five grams of Sodium Carbonate were added, and the mixture placed over a slow fire. 75 c.c. of stock iodine solution was then added slowly with continual stirring and moderate heating continued until the yellow colour disappeared. It was then taken from the fire, cooled and stored in clean well corked bottle. The Sodium Carbonate was added to control the Ph at from 6·8 to 7. During the experiment the solution was made fresh every day, but it has been seen that even in hot summer this protein can be kept three days at room temperature without any bad effect. 450 c.c. of the milk solution was fed at a time to each cow, equivalent to 14 grams of casein assuming 3·5% casein in milk.

Experimental.—In order to test the effectiveness of the iodized casein prepared as above, five cows were selected for the experiments. They were in the latter stage of lactation, with low milk yields. Three of them were fed iodinated casein and two were kept as controls. The protein was mixed with the concentrate and fed twice a day at milking time, at 11-30 in the morning and 2 a. m. The entire experiment was divided into seven periods of seven days each as follows—Preliminary 1st, 2nd, 3rd, 4th, 5th and 6th. Protein was fed in the 1st and 2nd periods, and again in the 5th and 6th periods.

In preliminary period cows were simply watched and only one day was iodinated casein given to all whether they would eat the mixture or not. The cows were not given any extra ration, nor any special care. They were subject to the same environment as other cows of the herd. 450 c. c. of iodinated casein was fed to each cow at milking time, the milk yield was carefully recorded daily and once a week fat tests were made by the Gerber method. After three days cow No. 719 was dropped from the experiment due to her bad habit of holding mik. So only two cows were treated with iodinated casein and the result is as follows :—

Average milk yield for each period.

	Cow No.	Preliminary period.	1st.	2nd.	3rd.	4th.	5th.	6th.
Treated ...	763	6·9	7·3	8·5	8·3	6·4	8·1	8·0
	785	1·8	2·2	2·8	2·5	2·0	2·2	2·1
Control ...	615	7·8	7·6	5·5	3·3	3·1	3·5	3·4
	642	4·2	3·8	4·0	2·2	2·4	1·8	1·9

Average fat% of each period.

Treated ...	763	5·5	6·5	6·8	5·5	4·5	5·4	6·2
	785	5·6	6·4	7·0	6·8	6·0	6·4	6·9
Control ...	615	6·2	6·2	6·0	6·1	6·3	6·4	6·3
	642	6·6	6·7	6·0	6·0	6·4	6·3	6·8

Cow No. 763 gave 23% more milk at the end of 2nd period and gave 7% less milk at the end of 4th period when iodinated casein was not fed. Again at the end of 6th week she gave about 17·2% more milk than the preliminary period.

Cow No. 785 gave 66% more milk at the end of second period than the preliminary period and again at the end of fourth period went down to 10% of the preliminary period and at the end of sixth period again went up to 22% more than the preliminary period.

In control Cow No 615 gave 3·9% less at the end of 2nd period and at the end of 4th period 60% less and 56% less at the end of the 6th period.

The 2nd Cow gave about same amount of milk at the end of 2nd period, but at the end of 4th and 6th period milk yield went down to 42·8 and 54·7% respectively.

Total percentage of fat.

	Cow number.	End of 2nd period	Foruth period.	Sixth period.
Treated ...	763	+23·6%	−22·2%	+12·7
	785	+25	− 7·1	+23·2
Control ...	615	− 3·3%	+ 1·5	+ 1·5
	642	same	same	+ 3·0

Cow No. 763 gave 23·6% more fat at the end of 2nd period than preliminary period and 22·7% less at the end of the 4th period and 12·7% more at the end of the 6th period.

Cow No. 785 gave 25% more at the end of 2nd period 1% less at the end of 4th period and 23·2% more at the end of 6th period.

Cow No. 615 gave 3·3% less at the end of 2nd period 1·5% more at the end of 4th and 6th period.

Cow No. 642 gave almost same at the end of 2nd and 4th period and at the end of 6th period gave 3% more fat.

Total milk yield.

Cow number.	Preliminary.	Second period.	Sixth period.
713	48·3 lbs	59·5 lbs	56 lbs
785	12·6	19·6	16·8
Total fat in Pounds.			
763	2·6	4·0	3·9 lbs
785	·7	1·4	1·1 lbs

1st cow gave 48·3 lbs. of milk in one week preliminary period, and in 2nd period gave 59·5 lbs. of milk to she gave 11·2 lbs. more milk and 1·4 lb. more fat. In 6th period gave 7·7 lbs. more milk and 1·3 lbs. more fat. Second cow gave 12·6 lbs. of milk in preliminary week and 19·6 on 2nd period so she gave 7 lbs. more milk and ·7 lbs. more fat. In 6th period gave 4·2 lbs. more milk and ·4 more fat.

The milk yield of both the cotrol cows decreased gradually during the course of the experiment and the fat did not increase appreciably. The experiment would, therefore, indicate that by feeding iodinated casein, prepared by the simple method indicated in this paper, increases both milk yield and fat yield of low producing milk cows in the latter stages of their lactation.

Advantages—

The advantages of this type of iodized casein are as follows :—

(*a*) Simply prepared so that even the ordinary herd man will be able to make it.

(*b*) Very short time is required for its preparation.

(*c*) No costly equipment is necessary.

(*d*) This iodoprotein has got about same stimulating value as thyroid proteins.

(*e*) No extra care is necessary for feeding the animals.

(*f*) It can be fed as daily supplement to regular ration.

(*g*) After effect of feeding is not at all bad.

(*h*) Skim milk in farms can be utilized in better way of best return.

(*i*) This iodoprotein costs only 0-3-0 per cow per day, at present value of chemicals and skim milk.

The experiment was for a short period one and with the low yielders. It is planned to repeat the experiment with a larger group of heavy yielding cows earlier in lactation periods. It would also be well to try an experiment on poultry to determine the effect on egg production.

REFERENCES.

1. Jack, E. L. and Bechdel, S. A study of the Influence of Thyroxim on milk secretion. Jour. Dairy Sc. 1935.

2. Turner C. W. Thyractin, a new source of Thyroxins for Dairy cattle. Jour. Dairy S. C. I. 1940.

3. Reineke, E. P. & Turner C. W. Formation in vitro of Highly active Thyropr tein, their Biologic Assay and practical use. Mo. Agr. Expt. Sta. Res. Bul. 355, 1942.

4. Pathology and Therapeutics of the Diseases of Domestic Animals Hutyra, Marek and Manninger Vol. II.

5. Reineke E. P. and Turner C. W. Increased Milk and fat production following the Feeding of Artificially formed Thyroprotein. Jour. Dairy Sci. 398, 1942.

6. H. A. Herman, W. R. Graham Jr. and C. W. Turner. The effect of Thyroid and Thyroxins on Milk secretion in Dairy cattle, Mo. Agr. Expt. Station Res. Bull. 275, 1938.

Acknowledgement.

The author is indebted to Dr. T. W. Millen ex-Head of the Department of Animal Husbandry and Dairying, to Mr. S. S. Bhatia, Head of the Department of Animal Husbandry and Dairying for their valuable suggestions in conducting the experiment and to Mr. A. P. Brooks, Head of the Department of Chemistry for his critical reading of the manuscript.

A *JUAR* GRASSHOPPER PEST, HIEROGLYPHUS NIGROREPLETUS BOL.

By. W. K. Wesley.

Rao found *Hieroglyphus nigrorepletus* Bol. reported as a fairly serious pest of *juar* in the Dhar State (Central India) in 1936 and near Tatta (Karachi district) in August, 1937. At Nellore (South India) also the grasshopper was found fairly serious on *sazza*.

Rao and Cherian (1940) reported the grasshopper from South India on *juar*, maize, *Setaria* and small millets as a minor pest. They did not consider it of much economic importance in the upland areas of Bellary, Karnal, Cuddapah, Guntur, Vizagapatam and Godavari from where it was recorded.

Uvarov reported it in the United Provinces, Bihar and Bombay.

The grasshopper has been reported breeding in nature on grasses in South Sind and in the Lasbela State during monsoons. It has also been collected from various places in Rajputana and from some localities in Mekran.

At Allahabad it has proved as fairly serious pest of *juar* during certain years when it was observed that the plants were simply reduced to midribs and stems in very many cases. However, the grasshopper has been observed to breed on grasses every year.

The life history as studied here was found to be similar to that of *H. banian* Fabr. reported by me in 1934.

Control in nature.

After heavy rains in 1929 and 1930 several instances of dead hoppers infested by *Empusa grylli* Fres., a fungus, were noticed in Ganjam district (South India).

Coleman and Kunhikannan recorded the presence of a nematode, probably *Cordius*, inside the body of the hoppers. In 1936, Menon, found that the inactivity and unproductivity of the grasshoppers was due to the infection of *Mermis nigrescens* Duj. in the body of the pests.

The larva of a small reddish mite, probably, *Trombidium* sp., has been reported present on the bodies of the adult hoppers. The larva was seen here also to attack the adult hoppers during July and August when a number of the individuals attacked were seen to die.

Susainathan (1914) found a few vertebrate predators of *Hieroglyphus* nymphs at Kilachery (Chingleput district, South India):—

Species of *Rana* were found attacking the nymphs, an observation which was corroborated by Menon in 1936 in Palghat Taluka. I have also made similar observations form 1943 to 1946 at Allahabad.

A water snake, *Tropidonotus piscator*, was reported feeding on the nymphs to some extent.

An examination of the gizzard contents of *Coracias indica* Linn., the Indian Roller revealed parts of *Hieroglyphus* and *Oxya* amids the contents. *Halister indus* Bodd., the Brahmani Kite and *Milvus govinda* Sykes, the Pariah Kite, were reported feeding on the nymphs. Susainathan also reported that the local cultivators were making use of ducks as a check on the grasshopper. Recently, *Corvus splendens* Vieill, the Common Crow, *C. macrorhynchus* Waglar, the Jungle Crow, *Acridotheres tristis* Linn., the Mynah, and *Dicrurus macrocercus* Vieill, the King Crow, were found attacking the pest at Belapur (Ahmednagar district, Bombay) when the hoppers and adults were driven out of an infested sugarcane field. They, however, did not enter the crop even when a perch had been provided for them. I have observed here the chickens feeding greedily on the grasshopper when they are allowed to do so.

The excreta, probably of jackals, contained broken pieces of skeletons of adult *Hieroglyphus* during the months of November and December at Samalkota. I have found here the Micro-chiroptera devouring a large number of these grasshoppers at night where strong lights were burning.

On the twenty-eighth of August, 1946, there was a very high flood in the river Jumna at Allahabad and the *juar* crops standing on the river banks were almost all under water which drove the hoppers into the open fields where they were preyed upon by a number of predators mentioned above and after that date not many grasshoppers were seen.

REFERENCES.

Rao, Y. R. and Cherian, M. C., 1940, Indian Farming, 1 (9) : 433-36.

Wesley, W. K., 1934, The Allahabad Farmer, 8 (5) : 176 77.

A short note on the life history of *Papilio demoleus* Linn.

The life history of *Papilio demoleus* Linn. as studied here shows that, although some of the caterpillars that pupate in late November pass the winter months of December to February as pupai under hibernation as pointed out by the previous workers, others keep feeding on and pass the winter months as caterpillers.

The following observations kept during the year 1942-1943 from December to May, shows the variation in the population of the caterpillars from month to month collected on one hundred *Citrus* of seedlings of about two years of age. The collection was made on or about the first of each month :—

Month	Number of caterpillars collected.
December, 1942	50
January, 1943	100
February, 1943	50
March, 1943	150
April, 1943	200
May, 1943	500

Reference Wesley W. K. 1944, The Allahabad Farmer XVIII (5).

"There are seven hundred thousand villages spread throughout the country which are the real India. The villagers must be made to realise their own inherent strength and capacities and taught to depend on themselves for their vital needs."

—MAHATMA GANDHI.

THE C/N RATIO AND ITS IMPORTANCE.

By

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All of us as students must have, at some time or other, noticed the emphasis being laid on the term "C/N ratio" by our professors, especially those of horticulture and Plant Physiology.

Some believe that the term "C/N ratio" means the carbohydrate/nitrogen ratio, still others understand this as the ratio of starch to nitrogen, while yet others take this as the ratio of total carbon to total nitrogen.

Let us see how the C/N ratio is important in the vegetative growth and reproduction of the plants.

The C/N Ratio as Effecting Fruitfulness.

In 1916 Fisher reported that when the ratio of carbohydrate to nitrogen was relatively low vegetative growth of the plant was favoured. He also found when the carbohydrate content was relatively high as compared to the nitrogen, reproduction was favoured.

In 1918 Kraus and Kraybill, working with the tomato, came to the following conclusions. According to them, " Fruitfulness is associated neither with the highest nitrates, nor with the highest carbohydrates, but with a condition of balance between them." They explained four conditions of plants as follows:—

(1) Plants which had a very low proportion of carbohydrates and nitrogen were in a weak vegetative condition and were unfruitful. These plants were decidedly deficient in carbohydrates. The deficiency was due to a low rate of carbohydrate manufacture by lessened photosynthesis. The plants had light green foliage. The growth in length was considerable, but the diameter increase was small The few flowers which were formed gradually fell off and the stems were grayish green and succulent. The flowers failed to reach full bloom and therefore could not set fruit.

(2) When there was low porportion of available carbohydrates to available nitrogen, plants were very vegetative but unfruitful. Chemical analysis revealed that these plants had little reserve carbohydrates but had a relatively high amount of available nitrogenous compounds. In these plants there was a mild carbohydrate deficiency. The deficiency was not due to the failure of carbohydrate synthesis but rather was a result of rapid utilization of carbohydrates in the formation of organic nitrogenous compounds.

(3) The plants included in this class flowered and fruited abundantly as a result of sufficient carbohydrate and nitrogenous substances. Carbohydrates were not limiting as in classes 1 and 2. The plants had considerable reserve carbohydrate but were lower in available nitrogenous compounds than those of class 2.

(4) The plants in this class were also weakly vegetative as in class 1. These plants had a high amount of available carbohydrates compared with the available nitrogen. They also had relatively large quantities of stored carbohydrates, but very little nitrogen in any form. In this class, as opposed to class 1, nitrogen was the limiting factor.

Hooker investigating fruit-bud differentiation in the apple, found that high starch and low nitrogen at the time of fruit-bud differentiation was essential for productivity.

Fruit-bearing spurs which developed leaf buds had low starch and a high nitrogen content and barren spurs which neither blossomed nor produced leaf buds had a low starch and a low nitrogen content.

In the apple it has been found that a high starch and a low nitrogen content, late in June causes fruit-bud differentiation.

Hooker also applied nitrogenous fertilizers to healthy apple trees in spring. On bearing trees he got an increased set of fruit associated with a greater nitrogen content of the spurs during the fruit setting period, while on non-bearing trees the effect was an increased rate of growth. Spring applications of nitrogenous fertilizers did not favour starch accumulation at the period of fruit-bud differentiation. The later in the season nitrogenous fertilizers are applied the greater is the nitrogen content of the spurs the following spring immediately before the growth begins.

Harvey and Murneek (1921) and *Harvey* (1923) examined the effect of defoliation and ringing of apple twigs and spurs with special reference to the C/N ratio. The defoliated spurs as compared to the controls contained more nitrate nitrogen, total nitrogen and insoluble nitrogen, more reducing sugars and less total carbohydrates and a smaller value for the C/N ratio. The bearing and sterile spurs showed extreme values while the non-bearing spurs assumed an intermediate position.

Howlett (1923-26) considered the lack of an adequate supply of N_2 rather than a lack of carbohydrates as a limiting factor in normal flower development in the case of the apple.

Gardner (1923), in the case of the strawberry, found that the maximum production of flower clusters, flowers, and berries was associated with those summer and fall treatments which led to the greatest accumulation of starch and total carbohydrates at the time of fruit-bud differentiation. He also noticed that low starch and low carbohydrate content at the time of fruit-bud differentiation led to the production of female flowers in a variety that is normally hermaphroditic. Thus apparently in the strawberry a low carbohydrate content is apparently associated with the female condition; high-carbohydrate content with the male condition, and an intermediate carbohydrate content with hermaphroditism.

From the above examples we see that a surplus of carbohydrates is a necessary antecedent to the plants becoming fruitful, that is, to its forming flowers-buds, fruits and seeds.

Carbohydrate Nitrogen Ratio and Photoperiodism.

Garner and Allard found that the light not only influenced the vegetative development of the soybean and tobacco but it also initiated the beginning of the reproductive phase. They divided the plants into two groups, namely, "short-day" plants and "long-day" plants. In the first group the flowering stage was accelerated when the plants were exposed to relatively short daily exposure. In the long-day plants prolonged duration of light accelerated the reproductive phase. They coined the word *photo-periodism* to express the relationship between the time of flowering and the daily length of the period of illumination. Thus some persons assume that the light requirements might be associated in some manner to the quantity of carbohydrates manufactured during the light period and its relationship to the nitrogen supply. The carbohydrate nitrogen ratio was utilised to explain photoperiodism.

As the duration of light increased the amount of carbohydrates manufactured also increased due to increased photosynthesis, which accelerated flower production. Thus it may be supposed that a correct C/N ratio was established at an earlier stage than would otherwise be possible.

Considerable difficulty was, however, experienced in explaining the behaviour of the " short-day " species. In this case short periods of illumination accelerated flower formation and it was difficult to explain this result on the basis of the C/N ratio, because a short exposure, which naturally gives a lesser amount of photosynthate manufactured accelerated flower production.

C/N Ratio in Different Stages of Plant Growth.

The carbohydrate nitrogen ratio has been found to be low in the seedling stage. It is considerably increased throughout the whole vegetative period. When the C/N ratio is highest, flowering is initiated. After fertilization the carbon nitrogen ratio decreases in the developing organs until a very low value is shown by the mature embryo.

Each plant strain has its own initial carbon nitrogen ratio value at which flowers are initiated. The best carbohydrate nitrogen ratio for one stage in the development of plants is not necessarily the best for other stages.

Variations of ratio in Different Organs of the Plants.

Hicks in 1928 analysed the carbon nitrogen ratio for different parts of the wheat plant at different stages of growth. He analysed different portions of the stem and root and from his experiments he concluded that the younger the tissue the lower the carbon nitrogen ratio.

Effect of the C/N ratio on root and shoot growth.

Much study had been made on the relation of carbohydrate and nitrogen on the root and shoot growth.

Roberts in 1921 showed that apple trees could absorb nitrogen, and store it as a reserve and later utilise it in growth. An abundant supply of carbohydrates stimulated root development. It has been observed that some twigs, cuttings or plants have an increased root development when grown in sugar solutions by Dachnowski in 1914, Knudson in 1916 and Curtis in 1918.

Starring (1923) in the tomato found that the best production of roots was obtained from cuttings which had a high content of carbohydrates. When carbohydrates were low the cuttings developed poor roots. No wide differences in root development could be secured by varying the nitrogen content.

Reid worked on the cuttings of tomato. Her results indicate that a high nitrogen supply plus a readily available supply of carbohydrates appear to furnish favourable condition for shoot growth.

Thus we see that a somewhat limited nitrogen supply plus a readily available supply of carbohydrates appears to furnish conditions for root growth.

Hicks (1928) concludes that shoots grow at the area of the lowest carbon nitrogen ratio and roots at the highest.

The significance of the C/N ratio in agricultural practice.

We have seen the important part played by the carbon nitrogen relationship in the vegetative growth and reproduction of plants. Besides this there are other external and internal factors which influence the type of growth, for example, the size of the plant, available moisture supply, and the length of the day.

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TURMERIC (*Curcuma Longa*) : ITS CULTIVATION AND USES.

By

C. P. K. Nair, B. Sc. (Ag.)*

1. Origin and Distribution.

Turmeric is reported to be a native of Southern Asia. It is seen in China and Indochina where this crop has developed into many forms due to age long cultivation. It is widely grown in India in many provinces. This crop is abundant in Bengal and Bihar, in the Kumaon and Gharwal districts of the United Provinces, in the Kangra valley in the Punjab, in Surat and Gujarat of the Bombay Presidency in the districts of Coimbatore North Arcot, Malabar and Guntur of the Madras Presidency and in the Ganjam Agency of Orissa. This crop is also grown in the native states of Cochin and Travancore.

2. Varieties.

Twenty-nine species of Curcuma are widely known. *Curcuma Longa*, the largely cultivated type, is mainly used as a condiment and dyestuff. *Curcuma Aromatica* (wild or Cochin Turmeric), *Curcuma Caesia* (Kalahaldi), *Curcuma Amada* (mango-ginjer), *Curcuma Zedoaria* (perfume turmeric), and *Curcuma Angustifolia* (India arrowroots) are some of the species of economic importance. There is a form of turmeric known as Karpur Haldi which emits camphor odour. Turmeric grown in the Ganjam Agency, Cochin and Travancore are reported to give higher out-turns than that grown in other areas.

3. Description and Behaviour of the Crop.

Turmeric is a herbacious monocot belonging to the family—Zingiberaceae. It has a tillering habit. The number of tillers generally depends upon the nature of seed material and the fertility of the soil in which it grows. Each plant produces at the most a dozen leaves during its life cycle. The leaves are 1½ to 2 feet long and about 6 to 8 inches broad. When the leaf is well pressed in hand it emits a special odour peculiar to itself.

Flowering in turmeric seems to be season bound. In the Ganjam Agency this crop is found to flower during the latter half of September. The flower comes out through the centre of the stalk. The plant produces no more growth after flowering. Seeds are reported to have no viability.

The underground portion is of economic importance. One year old plant gives a central bulb generally known as a Corm and 4 to 6 fingers known as rhizomes with 2 to 3 small offshoots in each weighing 25 to 30 tolas. A two year old plant produces a big central bulb and 6 to 10 fingers with 3 to 4 offshoots in each weighing 50 to 60 tolas.

In planting, pieces of rhizome or fingers are used. The dormant bud existing at the tip of the finger sprouts out of the ground and forms the shoot. Very soon a solid bulb is formed at the base and swells. It produces a number of dormant buds. Few of these buds sprout and form the fingers. These fingers develop lateral offshoots and form the mass of rhizomes. The rhizomes do not have any roots. The central bulb possess the roots. Some of the thin fleshy roots go down deep into the soil even upto a foot or more and develop fleshy tuberous structures These fleshy structures seem to store water for supplying to the plant during adverse seasons.

4. Climate and Rainfall.

Turmeric seems to be a tropical crop. It requires a fairly hot climate and heavy rainfall. In places where there is no sufficient rainfall, artificial irrigation has to be resorted to. In the Ganjam Agency, in the Malabar coast and in Ceylon this crop is purely grown as a rain fed crop. In the Ceded districts of Madras, irrigation is an expensive item in the turmeric cultivations.

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5. Soils.

Turmeric has been found to grow on many different kinds of soil varying from sandy loam to heavy alluvial soils generally found in the deltaic regions. It is a heavy feeder just like other root crops. Turmeric does not stand water logging. Hence, any tight soil rich in organic matter with facilities for thorough drainage will naturally be suitable to this crop. Any high land which has been cleared off its jungle can easily be utilised for growing this crop. In the Ganjam Agency the Khonds grow turmeric in the jungles after cutting down the vegetation and burning them. They do get fairly good returns.

6. Prepatory Cultivation.

Just like any other root crop turmeric requires thorough and clean cultivation. If the land is rough and the soil cloddy, planting will be difficult and germination poor. The roots will not develop properly and the outturn will naturally be low. Ploughing should, therefore, begin sufficiently early and continue at intervals till the planting is done. The plots should be ploughed and cross-ploughed half a dozen times at least so that the upper layer of the soil may get loose enough for the roots to develop and run through all directions.

7. Manuring.

As the crop is a heavy feeder application of sufficient doses of organic manure is essential to have satisfactory returns. It has been reported that turmeric requires nitrogen, phosphoric acid, potash and oxides of calcium and magnesium in sufficient quantities. Of these, potash is required in large quantities —at least 200 lbs. per acre. Nitrogen and phosphoric acid may be supplied at 30 lbs. each per acre. Magnesium and calcium oxides need not be applied as separate special manures because they are present in the soil as well as in the manure like Farmyard manure and ashes which are generally applied to this crop.

System of manuring to the turmeric varies from place to place. In the plains penning of sheep and cattle is a regular practice. 15 to 25 cartloads of Farmyard manure, 5 to 10 cartloads of ashes and 8 to 12 Mds of oilcake can be applied per acre.

In the Ganjam Agency the Khonda do not apply either Farmyard manure or oilcake. They have a sound system of manuring their turmeric crop through practical experience over ages. They generally apply 300 maunds of Sal twigs (green leaves with small branches) and 250 Mds of ashes per acre. The green leaves are generally applied as a mulch. Applications of artificial manures seem to have beneficial effects on this crop. Four maunds of ammonium sulphate and 3 Mds of potassium sulphate can be applied per acre with encouraging results.

8. Seed Materials.

The underground portion of turmeric consists of mother bulbs (Corm) and daughter rhizomes. The corm contain roots, scales and fibrous tissue and produce only low grade turmeric of commerce. The rhizomes are fleshy and clean and produce good quality turmeric. Hence central bulbs are used as seed materials in many parts of India.

In the Ganjam Agency both bulbs and rhizomes are used as seed material. When bulb is used as seed, the crop is harvested within one year while it takes two years to harvest when planted with rhizomes. Cut pieces of bulbs as well as rhizomes can also be used as seed material but they do not give encouraging results.

Full grown bulbs which bear a sprouting tendency at the sowing time may be selected. Those which are affected with any fungold diseases should be avoided. Cut or bruised, dried or rotten once may be discarded as far as possible.

9. Planting.

Different systems of planting are followed in different places.

(*a*) *Flat system.* In this the field is ploughed and manured. Then it is levelled properly. A country plough is drawn along the plot and the seed material is put one by one in the furrow at a distance of 6 to 9 inches according to the local practice. The furrow which is planted with the seed material is generally covered by the ridges of the adjacent furrow. This method is followed in the Ganjam Agency by the Khond cultivators. In this the seed rate used is rather high. It comes to 15 to 20 Mds per acre according to the size of the seed material.

(*b*) *Bed system.* Soon as the ploughing is finished the plot is levelled properly. Beds 3 feet wide, 6 to 8 inches high and of any convenient length are made. Seed material is planted in three rows 1 foot apart with 6 to 8 inches interspace from seed to seed. In this system 13 to 16 Mds of seed are required per acre. This is largely followed in West Coast and Ceylon.

(*c*) *Ridge and Furrow system.* After the field is ploughed and levelled properly it is laid out into ridges and furrows. The distance from furrow to furrow may be 1 ft, 2 ft. or 3 ft. On one foot ridge one line of turmeric will be planted and on two feet and three feet ridges two lines and three lines will be planted. The distance from seed to seed in a row may be about 9 inches. In this system the seed rate per acre is about 10 to 12 Mds per acre. This system is generally followed in places where artificial irrigation is resorted to.

Planting season. Planting of turmeric is generally done at the onset of the south west monsoon.

Spacing of turmeric. It is interesting to find that wider spacing is not favourable to turmeric. The crop responds to smaller spacing and gives better outturns. Nine inches spacing between row to row and the same distance between plant to plant seem to be more useful and paying.

10. Other crops grown with Turmeric.

Turmeric is widely grown as a mixed crop in the Ganjam Agency. Rahar, smaller millets, maize and hill paddy (early type) are grown in the turmeric field. After the planting of turmeric Rahar and maize are dibbled by hand between the rows of turmeric. In the case of paddy and smaller millets, they are sown broadcast in the plot after which the turmeric is planted in furrows.

11. Rotations.

In the Ceded districts of the Madras Presidency the turmeric is rotated with paddy in highlands where there is facility for irrigation. In the West Coast turmeric is rotated with rainy season vegetables, pulses and chillies. In the Ganjam Agency where the land is cheap and extensive, the turmeric is grown in the same land once in four years. After the crop is harvested the land is left fallow to get itself recuperated by the action of natural weathering agencies.

12. Hoeing and Weeding.

For the proper development of the underground portions of the root crops the soil near the base of the plants should be as loose as possible. This will help the easy penetration of the tender roots of the plants and the underground portions increase in size better Weeds do much harm to the root crops like turmeric. Hence much attention has to be paid for weeding as well. Two hoeings and two weedings are necessary for a one year crop of turmeric.

13. Irrigation.

In places where the rainfall is low the crop requires artificial irrigation. In the Ceded districts of Madras 4 to 5 irrigations are necessary to mature a crop of turmeric. In the West Coast as well as in the Ganjam Agency where the crop depends upon rainfall no irrigation is given to the crop which will facilitate easy digging.

14. Harvest.

The crop generally gets ready for harvest by January by which time leaves of the plants get dry. The dry stem and the leaves are cut with sickles and removed .Then the field is ploughed or dug with digging forks. The underground portions are collected by hand. The roots, portions of stems and the scales are removed from the mother bulbs. Bulbs and the rhizomes are separately collected from the field and taken to the godown. About two hundred maunds of green turmeric can easily be obtained from one acre. There are instances where the field has gone up to 400 Mds. per acre.

15. Pests and Diseases.

Turmeric crop is not generally subject to any serious disease or pests. During certain seasons the termeric shoot borer (*Dectocrosis punctiferalis*) cause dead-hearts in turmeric. Udaspus fulus (Turmeric skipper) larvae mine into the turmeric leaves. Both the pests do not cause appreciable damage.

There is a disease which affects the turmeric rhizomes both in the field and in the godown, the Coletotricum curcumae. The disease however is not serious.

PART II.

The green turmeric obtained after harvest is not fit to be marketed. It has to be cleaned, boiled, dried, polished and graded before selling to the traders.

1. Boiling and Drying.

(*a*) *Madras System.* The green turmeric is cleaned well. The earth and other extrenous matter are removed. Gur boiling pan or any other convenient vessel is filled with water and kept over the furnace. Some cowdung is mixed with the water in the vessel. Sufficient turmeric is put so that the cowdung water contained in the vessel will just cover the turmeric. Within 2 to 3 hours after the boiling starts, the turmeric gets soft. Then the boiling is stopped, water is drained and the boiled turmeric is removed to a shade where it is dried conveniently. The addition of cowdung to the water in which the turmeric is boiled is reported to have some effect on the keeping quality of the cured turmeric.

(*b*) *Bombay System.* The sides of the vessel in which the boiling is done are lined with dry leaves of turmeric. Sufficient green turmeric is put in the vessel. Cowdung water is poured over the turmeric, just to cover it completely. Dry turmeric leaves are put over the turmeric and plastered with a mixture of mud and cowdung. The boiling water generates steam and cooks the turmeric. This method takes only 1½ to 2 hours for the first boiling. Steam cooking seems to produce better grade turmeric of commerce.

(*c*) *Ganjam Agency Method.* In this the oven consists of a coup on the ground for feeding fuel with two or three round holes on the ground surface for placing earthern pots. Earthern pots are filled with water and the green turmeric is boiled. When the turmeric becomes soft and flat on pressing between the first finger and the thumb it is understood that the boiling is complete.

Drying. The boiled turmeric is generally dried in shade. Drying is done until it becomes brittle on breaking. 100 Mds. of green turmeric after boiling and drying comes to 20 Mds., *i.e.*, 20% of the green weight.

2. Polishing.

The boiled turmeric after it is dried does not have attractive appearance. So it cannot be marketed profitably. To improve appearance turmeric is generally polished before marketing.

Polishing is done in different ways :

1. The dry turmeric is rubbed against a rough surface with hands.

2. Pieces of gunny are tied on the feet of labourers and they rub the dry turmeric with their feet.

In the above two cases polishing is slow and not perfect. The process involved in these cases is so tedious that it cannot cope with the larger demands of the day. Naturally, modern machinery has come to be used.

Polishing is done both by hand machine as well as by power polishers. In Madras cultivators have begun to use the turmeric polisher introduced by the department of Agriculture. At Berhampur polishing is done by power.

Turmeric Polisher of Madras :

It consists of a perforated barrel 2 ft. long and 3 ft. in diameter. It is provided with a handle which can be worked with two men. 70 lbs. of turmeric is generally put into the barrel and the barrel is closed. Then the barrel is rotated with as great a speed as possible. The dry turmeric is violently disturbed inside. In so doing they beat against the perforated surface of the barrel as well as against one another. The turmeric when it gets such a treatment naturally gets polished. 70 lbs. of turmeric generally takes 30 minutes with 400 revolutions.

At Berhampur in Ganjam district about 80,000 Mds. of polished turmeric is exported every year. There polishing is done as side line in the rice mills with the help of steam power.

Method (A). In essentials the method is the same as the hand machine of the type described above except it polishes larger quantities at a time in bigger drums driven by power either steam or electricity. Hands machine can polish about 15 Mds. in about 8 hours whereas the power driven drum can polish about 100 Mds. with better results.

(B) Power. The power required by the turmeric plant is transferred from the main shaft of the rice mill by means of belts. Revolutions are adjusted and maintained by gear arrangment.

(C) Types of drums. At Berhampur two types of drums are being tried with varying degrees of success. They are: (1) Bombay drums. (2) Masulipatam drums.

Bombay Drums : Of all the types in use Bombay drum is the largest in size. It measures 5 ft. long and 5 ft. in diameter. It is octogonal in shape. The main body of the drum is made of multiple wooden reepers 2″ broad and 1¼″ in thickness placed close together leaving sufficient gap for waste powder to fall through. The two sides of the drum are closed with iron plates. The drum is lined with wire netting of ⅛″ meshes inside. An iron shaft passes through the middle of the drum which is connected by gear arrangement with the main shaft. The dry turmeric is filled just below the central shaft of the drum, and the drum is rotated according to the required speed.

Masulipatam type: Practically in all external and internal features it is same as that of the Bombay type except in this the gear wheels are directly attached to the side plates of the drum avoiding the necessity of having a separate gear shaft.

Kinds of polish: At Berhampur two kinds of polishing are in vogue. They are: (1) Anakapalle polish, and (2) Madras polish.

The difference between the above two polishes is that in the latter more polish is given than in the former. Anakapalle polish takes only 1¾ hours whereas the Madras polish requires 2 hours for a single charge Hence, there is a greater percentage of waste as powder in the Madras type of. polish than in the other.

3. Grading and Marketing.

Different grades of turmeric: (*a*) Selected fingers,
(*b*) Fingers,
(*c*) Mixed lots,
(*d*) Bulbs.

Best price is generally offered to the selected fingers and the lowest price to the bulbs.

Quality of turmeric is generally decided by the following features:

(*a*) By the formation and external appearance of the lot.

(*b*) *Colour.* The best colour is yellow. As the colour varies from yellow to bright orange and red, the quality becomes gradually inferior.

(*c*) *Length and hardness of the fingers.* Hard and long fingers naturally get better prices in the market.

(*d*) *Thickness of fingers.* Thinner the material the better is its quality.

(*e*) *Proper polish.* Turmeric which has been uniformly polished giving a uniform colour will fetch the best price in the market.

4. Uses of Turmeric

Turmeric has been used as a condiment and dyestuff. Bull coloured inferior ones are utilised for dye manufacture and the brighter coloured ones are used as condiment Some people use the leaves of turmeric also as condiment. Fishes when fried are well covered with the turmeric leaves to give them a peculiar flavour. It is largely used in the preparation of various Ayurvedic drugs. In Europe it is chiefly employed as a dye and as a chemical test for alkalies. The yellow colour of trumeric is due to the curcumin content (C_{21} H_{20} O_6) of which the drug contains 0·3%. When pure it forms yellow crystals having a vanilla odour and exhibits a fine blue colour in reflected sunlight. With potassium permanganate it gives vanillin. Vanillin is soluble in alcohol and chloroform. It is sparingly soluble in water. Paper tinged with turmeric becomes reddish brown on addition of an alkali. The reddish brown colour turns violet on drying which is a test in Alkalimetry, discovered by H. H. Vogel in 1815.

A REVIEW

OF

"PASHU PALAN POSHAN"

The book "Pashu Palan Poshan" is the second of its kind in Hindi language, the first one by name "Gopalan" being published more than twenty years before, though a more comprehensive but not giving up-to-date and valuable information as the present one. The amount of literature and its standard, on any technical subject or branch of science, in a language is a barometer of the popularity of that subject amongst people reading that language. On an important and vitally useful subject like Cattle Breeding and Dairying, immense literature was a necessity as improvement of cattle and production and supply of hygienically pure and ample milk to urban and rural areas of India is a crying need of the day. Poverty of literature is itself the proof of the present situation of cattle in India. Realizing this state of affairs, attempts are now afoot for improving this condition and the I. C. A. R. and the provincial and state governments have proposed as their Post War Plans some important cattle improvement measures. In order to obtain the co-operation and the agriculturists and masses literature is found of utter importance and a book like the present one is published at a very opportune time in a language, which is to be accepted as the language of India, due to the present political achievements.

Having impressed the necessity of scientific improvement in cattle breeding by given facts and figures in chapter I, the author proceeds to give hints for selection of cows in chapter II, the different breeds of cattle in India with their important characteristics, in chapter III. Chapter IV deals with the care and managment of pregnant cows, and chapters V to VII give details peculiar to care and managements of bull calves and heifers. Chapter VIII describes the proper care at the time of first calving of a cow from the time of service. Chapter IX is full of different records to be maintained in order to study the value of individual animal as well the economics of the whole industry. Chapter X is very important as the selection of a proper bull plays very important part in the improvement of cattle and their yields etc. The bullock-power which is the only means of cultivation and other important functions like transportation of materials, waterlifting, etc., deserves proper attention. Chapter XI has been written on the good and bad points of bullocks and their feeding. Though the cow plays its unique important role in the economics of India, the value of buffaloes for production of milk and butterfat cannot be ignored; a full chapter XII is devoted to the important breeds of buffaloes, giving their characteristics.

Chapter XIII deals with the breeds of sheep in India. It will be out of place to discuss in details the important part of wool industry, but it must be accepted that India is a rich source of this commodity, and improvement measures in sheep breeding are essential as it can be seen that the average production of wool in India is lesser than what it is in many other countries where improvements are in progress. "Goat is poor man's cow", and in a poor country like India the goat must receive proper attention in the interest of masses. It is quite natural that one full chapter XIV should describe different breeds in India and steps for the development of goat industry.

Livestock is prone to suffer from different ailments as human beings and as chapter XV deals in Vety. Science. In the absence of countrywide enactment of prevention and control of contagious diseases, it is quite essential that the agriculturists and masses must be thoroughly acquainted with the different measures and it is but natural that for the information of all concerned one complete chapter describes in brief everything about the diseases and their treatment. "Breeding and Feeding must go hand in hand", and as such the cultivation of varieties

of exotic grasses and liguminous fodders is very important in a country where on an average protein is the first and foremost deficient constituent in feeds of livestock, though minerals and vitamins play a minor role. As such, hints for cultivation of these are quite appropriate and chapter XVI will provide the necessary information. Out of season, there is great scarcity of fodder, and preservation of fodder is a very interesting and important side of feeding problem. The technique of silo and different silos have been described in chapter XVII. The growth and function of udder, the formation of colostrum and milk and some diseases of udder are described in chapter XVIII. I would have liked the author to supplement this chapter by providing some pictures giving the students a full grasp of the intricacies inside the udder. Chapter XIX deals with constituents of milk, production of hygienical clean milk and further treatment, testing of milk and some diseases transmissible through the media of milk to human beings. Chapters XX to XXIV describe the scientific and indigenous preparations and products from milk in the country.

I would have liked if the author could have given at the end of every chapter a short summary which would have been of immense value especially to agriculturists and others who would make the best use of cardinal points stated therein. The author could have made the book more informative and interesting by providing more pictures and diagrams in his book. No doubt, the author has taken great pains to collect information from various sources and put it in a very simple language. Animal breeding is an art and a science, and as such scientific knowledge to be expressed in a local language is a hard task. I can say that the author has successfully given out a valuable contribution which will be of great use to students and all interested in cattle improvement.

—*S. H. Bapat, Vety. Dep., Baroda State.*

THE C/N RATIO AND ITS IMPORTANCE.

Continued from page 145.

Hooker (1925) enumerates various ways in which carbohydrate nitrogen relationships may be varied.

The carbohydrate content may be increased by girdling, by thinning, and by the application of nitrogen at certain times. It may be decreased by shading, shortening the daily period of illumination, defoliation, manuring with nitrogenous fertilizers, etc.

The nitrogen content, on the other hand, can be increased by manuring, shading, defoliation and certain types of pruning. It may be decreased by girdling, or defoliation early in the season, or pruning, and in some cases the insoluble nitrogen may be increased by shortening the day. The nitrogen content may also be decreased by sod.

For a time the ratio was used to explain nearly every manifestation of the plant. Work has, however, pointed out:—"When two factors play as complex and various parts in plant metabolism as do nitrogen and carbohydrate, each being present in more than one form, and each being assigned a multiple role, it is hardly to be expected that their relation to each other may be expressed by a simple mathematical ratio. This would imply that the two are interdependent variables, and that together they constitute a factor which conditions the activity of the plant-in this case, vegetative and reproductive activity."

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THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL

OF

AGRICULTURE AND RURAL LIFE

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THE ALLAHABAD FARMER

A BI-MONTHLY JOURNAL OF AGRICULTURE AND RURAL LIFE

The ALLAHABAD FARMER is now approved by the Directors of Public Instruction in the United Provinces, Bengal, Central Provinces, Sind, Assam, Bihar and Orissa, the Rural Reconstruction Commissioner, Punjab, and by the Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to Rajputana and Central India States, for use in all schools under their jurisdiction.

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Annual subscription: India, Rs. 3; England, 4 shillings; U.S.A., 1 dollar. Single copies 10 annas; over five years old, 12 annas. Copies which are not received by subscribers will be supplied free of cost within six months of the month of issue. Thereafter single copy prices will be charged.

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Contributions

The ALLAHABAD FARMER is published in the first week of each alternate month commencing with the month of January. Contributors are requested to send in their articles at least one month prior to the next prospective date of publication.

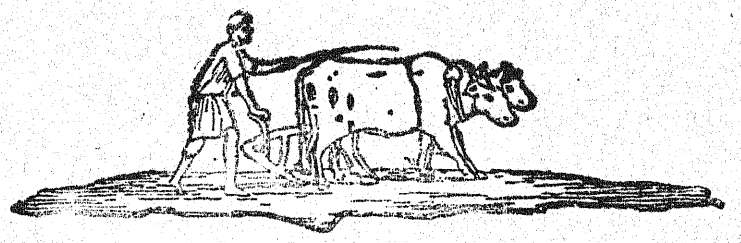
Contributors will receive 15 reprints of the article published and additional copies at cost.

Publisher—The Allahabad Agricultural Institute, Allahabad, U.P. (American Presbyterian Mission).

Printer—The Mission Press, Allahabad, U.P.

THE

ALLAHABAD FARMER



VOL. XX] NOVEMBER, 1946 [No. 6

Editorial

How much and what kind of shelter can be economically justified for Indian milk cattle ? How much for work cattle ?

In Western and particularly Northern countries, fairly extensive studies have been made on the effect of temperature and other climatic effects on the milk production of heavy milking cows As a matter of course, some shelter is provided for milk and work animals, but in many places having far worse climates than the Plains of India, no shelter whatever is provided for other animals.

We have seen no discussion or report of research on the effect of shelter or its lack for Indian cattle under Indian climatic conditions. The need of some shelter for young calves born in winter seems to be established. It is undoubtedly a convenience for the milker to have a shelter with easily cleanable floor for milking, but this can be provided for by a comparatively small structure in which the animals can be milked in rotation. We sentimentally compare our own comfort and think that animals need the same sort of protection. Has any one watched a herd of cows to see whether they go in to shelter where they are not fed to escape from rain ? Cattle do lie in shade in hot weather. If shelter is provided for shelter only, not for feeding, will they go inside a barn or prefer to lie outside in the shade of trees ?

Though as yet it has had very little attention from agricultural workers, there is a fermenting desire for better homes in the villages and if and when building materials become more freely available, it appears likely that there will be much rebuilding of existing villages. The drive for increase of cultivated area will doubtless lead to the building of new villages. What shall we recommend to those wishing to build new cattle shelters ? Shall we base our recommendations on what we think we would find comfortable ? Have we or can we get any objective measures of the value of shelter in increasing the production of milk, meat, or wool by Indian animals ? If such increase is demonstrated, what is a suitable basis for capitalising it in the form of shelter to be built ? We expect implements and machinery, animals and other facilities for production to pay interest on the investment and depreciation in the form of increased earnings. Do our animal shelters earn interest on the investment in them plus depreciation, in the form of increased production which would not occur without the shelter ?

When I have raised this question with individuals and classes of students, the question of protection from wild animals and thieves usually comes up. Are our present recommended buildings economical means of providing this protection? What would be the percentage loss without the buildings from either of these dangers? Can we provide this protection to the degree needed by some cheaper means?

Both Agricultural Engineers and Animal Husbandry men are asked for recommendations about plans for cattle shelters. What can we recommend with the confidence that our recommendations can be supported by reliable scientific evidence?

—MASON VAUGH.

AGRICULTURE IN THE MONBA COUNTRY OF THE BALIPARA FRONTIER TRACT, ASSAM.

By

B. M. PUGH*

Assistant Agricultural Officer, North-East Frontier Agency.

Geography of the Area.

The Monba area lies in the extreme North-West of Assam and occupies practically the whole of the Western Section of the Balipara Frontier Tract which is bounded on the South by the Brahmaputra or Assam Valley, on the West by Bhutan, on the North by Tibet, and on the East by the Sadiya Frontier Tract. The Monba area, which is inhabited by the Monba tribe, is a very mountaneous country with several valleys. The mountains vary in height from about 6,500 ft. above sea level in the lower ranges to about 15,000 to 19,000 ft. in the upper ranges which really constitute the Eastern ranges of the Greater Himalayas. However, the usual heights of the mountains in the central area of the Monba country are from 8,000 to 10,000 ft. The valleys and the neighbouring mountain slopes in which crops are grown are at elevations varying from about 5,000 ft. in the extreme East of the area to about 10,000 feet on the West and North West. The main river flowing through this area is the Digien with its many tributaries, the most important of which is the Dzingkhe river. The Digien flows through the Dirang Dzong valley and the Dzingkhe through the Sherdukpen (Shergaon and Dukpen or Rupa) valley. In fact, the whole area is a series of mountains and fast flowing mountain streams or rivers. The Digien flows into the Bharoli river which later joins the Brahmaputra.

The area is practically unexplored, as very few officers had been into the area, and even they in lower elevations only. The means of communication with Assam and the rest of India are very difficult mountain paths through very thick tropical forests about 40 miles in width, which are almost impenetrable in the rainy season. The area is for all practical purposes considered closed as far as communications with Assam is concerned during the rainy season. All trade, the little that there is, with India, is closed during that season. On the other hand, communications with Tibet and Bhutan with the area remain closed during the winter as it is difficult to negotiate the mountain passes because of the cold at that time, and are, therefore, open only during the warm season of the year, which is from March to November.

The climate of the area is similar to the climate of central European countries, for once the tropical forests on the southern slopes of the outer foothills are crossed, the area receives a very moderate rainfall. The annual rainfall at Dirang Dzong at the centre of the area, in 1945-46, the first year in which rain-

*The officer visited the area from the 17th November to 6th December, 1946.

fall was recorded, was only 46 inches. It is probable that the Rupa valley south of Dirang Dzong valley gets a little more, say about 50-55 inches; but the amount of rainfall in the north-west, namely, in the Senge Dzong area, must be about 35 to 40 inches. However, this latter area gets much of its moisture from frost and snow. But while snow is quite common at higher elevations, i.e. 10,000 ft. and upwards, especially in the winter, snowfall in the valleys is rare.

The area is practically 100 miles in length and about 150 miles in width. It lies between 91°45′ and 92°45′ longitudes and between 27° and 27°50′ latitudes approximately.

The main occupations of the people of this area are agriculture, that in the raising of crops and animals; trade with India, Tibet and Bhutan as mentioned above; spinning and weaving; the making of various kinds of alcoholic drinks; the grinding of grain into flour mostly with the help of water mills; and, in one village, paper making.

The most common forms of vegetation on the mountain slopes are oaks, rhododendrons, various pines, and various small shrubs such as *Gaultheria fragrantissima* from which wintergreen oil may be obtained. In the valleys are *Docynia indica*, known in the Khasi Hills as *Sonphon Khasi*; *Pyrus baccata* or crab apple, which may be used for grafting apples and other pome fruits; *Barberis sp* which is supposed to be a host plant of wheat rusts; *Viburnum foetidum*, a wild fruit known in Khasi as *son lang*, which is eatable and is also commonly used as bait for fish; and, in some places *Zanthoxylum alatum*, the seed of which is very much valued as a spice by the Frontier people.

Tigers and wild elephants do not seem to occur in the area. Occasionally, however, they may leave the tropical forests on the southern slopes of the most southerly ranges and may be seen near the Sherdukpen area. Wild pigs are fairly widespread in the area but are found in most abundance on the slopes of Thongpu La mountain, half way between Shergaon and Dumkho-Marsingh. Barking deer are also quite common. Wild ducks are also plentiful on the rivers and streams. The most common fish in the streams of the area seems to be snow trout.

Crops grown in the area.

(i) Grain crops.

The most common grain crops grown in the area, arranged more or less in their order of importance to the local people, are rice, buck-wheat, barley, wheat, maize, finger millet. (*Eleusine coracana*), grain cockscomb, foxtail millet (*Setaria italica*), broomcorn millet (*Panicum miliaceum*) and *Job's* tears (*Coix Lachryma-Jobi*).

RICE is perhaps the most common grain crop in the area, but its cultivation is confined to the valleys up to an elevation of about 6,700 ft. above sea level. Practically, all of the rice grown in the area is in wet terraces, some of which are well made. But in most places these terraces could be longer and also wider in order to allow a more economical use of bullock power by avoiding too many turnings. While the local people have made much use of lands suitable for wet rice terraces, yet it appears that there are still areas that can be so used, such as those in the Shergaon and Rupa-Sanchong area. While it appears that there is only one variety that is grown extensively in the area, a further study of the varieties in October or early November may reveal the presence of other varieties adapted to special areas. The study of the varieties in the area and the trial of new ones from other hill areas is, in my opinion, the first step in the improvement of the yield of this crop in this area.

BUCKWHEAT (*Polygonum sp.*) is a very common grain crop grown in the area. Although it is not technically a cereal, yet, as the seeds are ground into flour which is used in a manner similar to the flour of wheat or barley, hence it may be considered as a cereal or grain crop.

There are two varieties of this crop. One of them, known locally as Grunchung is reddish-stemmed and possesses big seeds. This variety does not seem to grow well at higher elevations and is, therefore, mostly confined to the slopes up to about 7,500 ft. The other variety known locally as Brasma has greenish-yellow stems and smaller seeds which are bitter in taste. This is mostly grown at higher elevations and also, it seems, on poorer soils, as it is probably more hardy than Grunchung. Brasma is found up to 10,000 ft. at Senge Dzong. Buckwheat is a very short-seasoned crop. It is generally sown from the 3rd week of August to the 3rd week of September and harvested in October-November.

The most rapid method of improving this crop in order to increase the yield may be the introduction of new varieties, after proper trial, from other hill areas of India such as Almora and Naini Tal, or by the introduction of European varieties from Germany or Russia.

BARLEY (*Hordeum vulgare var. nuda*) is another important grain crop of the area and is known locally as "bong." This is, unlike the buckwheat, a winter crop, but both of them are "naked," that is without a husk attached to the grain after threshing. One of these varieties possesses long awns or "beard," while the other variety is "hooded," that is, it possesses a hood in place of an awn. Both the varieties are grown in the winter and therefore are, unlike the barleys on the plains of India, very resistant to frost and snow. In fact, the crop gets a great deal of its moisture from frost and snow. The main crop of barley is sown in November-December and harvested in April-May.

Any attempt to improve the yields of barley should consist in studying those two varieties and any other that may be grown in the area with a view to selection for yields and adaptability in various parts of the area. Introduction of winter barleys from European countries, the United States of America, or Canada, may be attempted later after we are thoroughly acquainted with the existing local varieties.

WHEAT (*Triticum vulgare*), known locally as "rembong," is another very important grain crop of the area, but its acreage appears to be less than that of barley. It appears that the local people in general prefer barley to wheat as a crop. Unlike the conditions found on the plains of India, it also appears that wheat is grown in poorer soils than barley. This observation may be confirmed later.

The wheat grown in the area seems to belong to the common bread wheat, so common throughout the world, but it is a variety that can also withstand frost and snow well. It is sown at the same time as barley and also reaped at the same time. The people of the area claim to possess only one variety, although there are heads with various lengths of awns in the wheat obtained from the same field. The wheat crop in the area may, therefore, be a mixture of varieties.

In order to increase the yield of this crop, it is necessary to study the local crop, with a view to selection of the best strains. Later, some outstanding winter varieties from the West or from the North-West Frontier Province may be introduced after observation and trial in the area itself.

I was told that the wheat of the area is not attacked by rust. This should be confirmed, as the fact may later prove to be of immense advantage to wheat breeders.

Wild pigeons seem to be a very bad pest of wheat as hundreds of them light on a wheat or barley field just after sowing. They may, however, pick up only those grains that are exposed and not covered with soil.

MAIZE (*zea mays*) is also a popular warm-season crop of the area. There are various varieties of it, but all of them belong to the Flint type of maize. These are kept more or less pure as it appears that there is very little cross-breeding in the crop. Some of these varieties produce very good ears. It is

doubtful if anything should be done immediately to improve the yields of this crop by selection, introduction or cross-breeding. Any introduction of a new variety from outside might affect the present varieties adversely by cross-breeding. However, a study of the local varieties should be made with a view to find out their special uses and/or adaptibility.

FINGER MILLET (*Eleusine coracana*) is by far the most common of the three or four millets found in the area. It is grown in the warm season in poorer soils than those used for other grain crops, but in better soils than for other millets. It is a good millet to grow, and is, from the point of view of nutrition, better than the other millets. It is sown in June-July and harvested in October-November. After the crop is harvested, cattle and horses are also let loose to feed on the straw left behind in the fields. It appears that the crop is also a mixture of varieties as some heads have only five "fingers" whereas others have up to nine "fingers." This should be studied with a view to selection of improved strains. Samples of this millet may also be sent to the Millet Specialist, Coimbatore, who, in return, may send his improved types for trial in the area.

GRAIN COCKSCOMB is generally sown as a mixed crop with finger millet. There are two types of this crop; one which is locally known as Mo is green-stemmed and has white seed and the other, known as Mocholo, is red-stemmed with black seeds. The seeds are used as grain and not for oil. The crop, however, is not important, so that for the present it may be left alone.

FOXTAIL MILLET (*Setaria italica*) and *BROOMCORN MILLET* (*Panicum miliaceum*) are minor millets and are grown in very limited quantities in the area.

JOB'S TEARS (*Coix Lachryma-Jobi*) is found in the area, but is not usually cultivated. A wild variety with large seeds is found near cultivated fields. Job's Tears from the Naga Hills and other hill areas of Assam may be introduced.

(2) Pulses.

SOYA BEAN is the only pulse crop found in the area. It is now grown as a mixed crop with maize. An introduction of better varieties from other hill sections of India such as Almora and Naini Tal, or from China and Japan may improve the yield and the quality of the crop. As it is a leguminous crop which helps add nitrogen to the soil, a more extensive use of the crop may be encouraged.

(3) Vegetable Crops.

CHILLIES seem to be the most common vegetable in the area. They are eaten as a vegetable and not as a spice. The roofs of the houses of whole villages in the area are sometimes covered with red chillies drying, giving a very attractive appearance to the village when viewed from a distance. It seems there is one variety which is extensively grown in the area. It bears fairly large fruits, and is not very hot. It is doubtful if anything should be done to this crop.

RADISH is another very common vegetable crop of the area. The variety sown is excellent and should be introduced to other hill areas.

POTATO is not as yet a very popular vegetable. The area, however, is quite suitable for growing potatoes. Two varieties were noticed on my tour; one with small tubers is considered to be a local variety, while another with bigger tubers is said to have been introduced from Shillong. The local cultivators claim that the local variety yields more per acre than the Shillong variety. Further trials may be made with other varieties from Shillong such as Arran Consul, Inverness Favourite and Up-to-date.

SWEET POTATO also grows well in various places, but the local people have perhaps not greatly relished it.

OTHER VEGETABLES such as lettuce, cabbage, cauliflower, tomato, brinjal, celery, pumpkin, gourd, turnip, pea, French bean and okra, grow quite well, but the local people have not quite learned to eat them. It is particularly unfortunate that tomatoes are not eaten at all. A wild tomato (love apple) grows wild in fertile soils, but Monba children pay no attention to it, although the fruits are very sweet. Attempts should be made to popularise these vegetables.

(4 Fibre Crops.

A species of nettle which grows wild in the area and rhea (ramie) seem to be the only sources of fibre in the area. I also came across cotton which appears to be *Gossypium barbadense* (Sea Island or Egyptian cotton) at an elevation of about 5,000 ft. The plant seems to do well although the bolls had not ripened when I visited the place. The leaves of this cotton are three lobed, the bracts are deeply serrated, and the bolls are fairly large and pitted. Neither flowers nor cotton fibres were obtainable at that time, so that it could not be properly identified.

(5) Spices.

The only spice found in the area is what is known locally as *jabrang* (*Zanthoxylum alatum*) and known in the Khasi Hills as *jaiur*. This plant grows wild, but its seeds with the coltx (sepals) are carefully collected and used as spice locally or for export to other areas.

(6) Drugs

Some tea plants were found at Khong at an elevation of about 7,000 to 7,500 feet above sea level, but the local people do not seem to be acquainted with it.

The Monbas, however, make tea out of alder leaves.

(7) Fruits.

There are practically no fruits grown in the area although I found some orange trees at Chepjang near Dirang Dzong. The fruits, however, are quite small and somewhat sour. The area should be very suitable for all deciduous fruits such as apples, pears, peaches, plums and pomegranates.

Systems of Cropping

The systems of cropping in the area seem to depend mostly on the lay of the land and its elevation. In areas which are capable of being converted into wet terraces the main crop is rice. This is usually not followed by any other crop, although it seems possible to grow, with heavy manuring, winter wheat after rice had been harvested. On poorly terraced lands the main crops are maize and buckwheat or finger millet. Maize is sown in the early summer followed by buckwheat. In some fields of maize, soya bean is sown after the maize has grown a few inches. Finger millet, however, is not usually followed by any other crop. More commonly the fields of finger millet contain also a crop of grain cockscomb (Mo and Mechola). On slopes which are left almost without any attempt at terracing, and where the soil is sometimes kept from moving downwards with stones or fallen trees, the main crops are barley and wheat. In very poor soils foxtail millet or broomcorn millet is grown.

Elevation, with its accompanying heat or cold, seems to determine how many crops can be obtained from a field in one year. At Nyukmadong (about 8,000 ft.) and Senge Dzong (about 10,000 ft.) only one crop a year can be grown. The common crops in these regions are the bitter buckwheat, barley and wheat. But at Khong (about 6,500 to 7,000 feet) two or three crops are obtained in one

year. In this section the forest or grass area is cleared by cutting and then fired. The first crop generally sown is maize which is sown in March and harvested in June-July. But before the maize is harvested, potatoes are sown between the plants of maize and harvested in August or September. As soon as the potatoes are harvested buckwheat is sown, and the crop is ready for harvesting in November. These fields are then left fallow. In other fields, maize is followed by wheat. The latter is sown in October or early November and is harvested in April or May.

These systems of cropping must have been evolved through years of experience, and seem to be quite suitable for their various localities. However, the growing of the soya bean may be encouraged wherever it suits their economy, as this crop, like most legumes, has the property of enriching the soil. The practice of growing soya beans with maize as is done in Chepjang near Dirang Dzong is highly to be recommended.

Manuring

The Monbas are acquainted with the value of farmyard manure. This is usually applied to the maize crop which is sown in the early summer. The residual effect of the manure on the succeeding crops seems also to be realised. Previous to the sowing of barley or wheat their animals are tethered in the fields which are thus manured by droppings from these animals.

Very extensive use is also made of the oak leaves. Large forests of this tree are preserved, acorns being planted where the trees are thin. The leaves are collected in December and January and heaped in a pile until they begin to rot. These are then spread on the fields of maize and raked in.

In order that oak leaves may rot properly, watering the pile may have to be resorted to. A starter of well decomposed farmyard manure or well-rotten leaf-mould may be added in order to hasten the decomposition. Composition of oak leaves with farmyard manure may also help to increase the amount of manure available.

Alder leaves and cosmos which grows wild in some places may also be used in composting. It also appears that a species of wild indigo (*Indigofera sp.*) grows profusely in certain areas much as on the northern slopes of Bondi La facing Rahung. This plant may be tried for regenerating fields depleted of nitrogen or for composting with farmyard manure.

Animal Husbandry And Dairying

COWS in the area are of two kinds each of which seems specially adapted to its own area. The first type of cattle seem to be hybrids of mithan or gayal (*Bos frontalis.*) These animals are fairly big in size, much larger than the cattle of the Assam Valley. However, the yield of milk is poor, although perhaps not poorer than that of the cattle of the plains of Assam. The average cow of this type does not yield more than 2 to 2½ seers of milk a day. Milk yields of this type of animals can easily be improved by cross-breeding with foreign breeds such as the Holstein-Friesian, Jersey, Guernsey, or Brown Swiss. As the local cattle are very tractable and may be more resistant to diseases than European breeds, it may not be desirable to have too much of the European blood in them. However, a pure herd of European breed may be kept for observation in the area.

These cows live only on pasture; they will graze on grasses on the mountain slopes or in harvested fields of maize or finger millet, etc. If superior cattle are evolved or brought to the area, they must have a better supply of fodder.

Both bulls and bullocks are used for ploughing. But as the bulls are very active and somewhat easily excited, it would be preferable to castrate all but the breeding bulls. Castration, as is practised now in the area, is a painful and difficult process. If "Burdiggo emasulatomes' can be secured and made available, the operation can be more easily performed.

Another type of cattle found in the area are those which are raised at higher elevations, from about 8,000 ft. upwards to the snow line. These are hybrids of yak (*Poephagus grunniens*) and *glang* (?). The yak is a fairly large animal weighing about 700 to 800 lbs., and possesses long hair especially towards the abdomen. It also possesses long horns that are well spread out. The animal is very agile and quick in its movements. Its habits are somewhat wild. It lives almost altogether on pasture, but is also fond of ground grain. The glang, on the other hand, is a smallish animal weighing about 200 to 300 lbs; its height being only about 3 to 3½ feet. The hair is somewhat long especially on the sides, and greyish-black. It is also a slower animal and seems more docile. In appearance it somewhat resembles a donkey. The hybrids of these two animals present a very interesting problem in animal genetics. It seems that the Monbas are masters in the art of animal breeding. They not only make use of the phenomenon known as heterosis or hybrid vigour in the crossing of these animals, but are also acquainted with the probable results of breeding these animals in various combinations. But in every case only pure-bred yak and the glang bulls are used in breeding. The Monbas claim that the hybrid males are sterile. This should be confirmed, and studied if true.

The most desirable animal seems to be the jommu, a female *joppa* or *dzoz* or *je*, which is a hybrid of a glang bull and a female yak, known as *bree* or *dhee*. The jommu is considered to be the best milker of all the hybrids obtained from their several combinations even better than the *pamjommu* which is the progeny of a male yak and a *glangmu*, a female glang. The jommu is a medium sized animal weighing 500 to 600 lbs. and gives about 4 to 6 seers of milk a day. The je is a very useful beast of burden.

In order to control the breeding of glang and bree, the hind parts of the bree are covered with a cloth until a suitable moment arrives for the small glang to mate with the bree, a much bigger animal. This opportunity often comes when the glang and bree are left alone and when the bree is going down the slope. And in order that this female yak be not served by any other animal, the hairs near the vagina of the bree are fired so that the vagina of the animal becomes very delicate and sensitive, and, consequently, it no longer allows any other animal to serve it.

I am of the opinion that a study of the progeny of the various combinations of these animals is one that will help advance the science of animal genetics in this country.

In order to increase the fodder for these cattle, several methods may be adopted. I would first recommend the growing of lucerne (*Medicago sativa*) and oats. Other fodder crops such as the species of *Saccharum* known in Khasi as *pai kdait* and now grown on the Upper Shillong Farm, berseem (*Trifolium alexandrinum*), giant sunflowers and mangolds (*Beta vulgaris*) may be tried. A village silo pit may also be dug where there is a large herd of cattle. Hay-making by the method described by Dr. Talapatra (See the annual report of the cattle nutrition scheme, Assam, for 1945-46) may also be adopted.

The Monbas keep large flocks of sheep, as the wool is used locally for clothing. The breed of sheep seems fairly good, as it possesses fairly good wool, though not as long as that of the Romney Marsh, the Australian breed which we now have on the Upper Shillong Farm. But, whereas on the Upper Shillong Farm they have only one shearing in a year, the Monbas shear their sheep three times. On inquiry it appears that the amount of wool obtained per sheep in the Monba area is also higher than that obtained on the Upper Shillong Farm. So, while I would wish very much to recommend the grading up of the local breed with the Romney Marsh in order to improve the quality of the wool, yet this may result in lower yield of wool which would be a disadvantage.

Careful investigations and observations would, therefore, have to be made before anything is done about this. Inquiry seems also to indicate that the yield of wool in the higher or cooler regions of the area is better than in the lower and warmer regions. This may have to be verified.

GOATS are also plentiful in the area. They are of a breed that seems admirably suited to these mountainous regions as they are active and appear to be very sure-footed. Goat's milk is not consumed. When the Monbas learn to drink goat's milk, the Jumna Pari breed of the United Provinces may be used for crossing with the local breed to increase the milk yield

PIGS are also plentiful in the area. They are a smallish breed, but may grow bigger if better fed. At present they get only the husk of grain or leavings from the kitchen, and also serve as scavengers.

Cross-breeding with European breeds, such as these now in the military dairies in Shillong, may improve the size of the breed.

POULTRY consists of chickens only. The breed of chickens seems fairly good, but are not good layers. The breed may be improved in size and egg laying by the introduction of Rhode Island Reds or White Leghorns. Nyukmadong (6,000 ft.) is the village with the greatest number of chickens and eggs in the area. The village may be presented with some Rhode Island Red cockerels. Eggs keep very well at this place because of the cold

HORSES in the Monba area are the most common beasts of burden. They are very tractable and docile. The breed may be improved by the selection of sires. We may also attempt to use horses in farming operations.

BEES occur almost altogether in a wild state. Except at Rupa, bee-keeping seems to be considered against the religion of the Monbas. A model hive or two at Rupa may popularise bee-keeping in the area. If this industry is developed, it may prove a source of income to the Monbas. The bees' fodder may consist of flowers of the radish, sunflower, buckwheat, various cucurbits, and many other flowering plants such as the rhododendrons which thrive so well in the area.

DOGS in the Monba area are of three types. The large type, very similar to the shepherd dog, is used in rounding up cattle and as watch dogs at night. They are very fierce and strong. The medium type is a hunting dog, very much like the pariah of the plains in appearance. The third type, the pug is the smallest, weighing only 6 to 8 lbs. when full-grown. It is a lap dog and, useful only as an alarm clock.

DAIRY PRODUCTS in the Monba area are *churpin*, a local cheese, and *moh*, a local butter or ghee. Both are very poor as cheese and butter or ghee respectively. These are manufactured mainly from the milk of the yak hybrids which seems to be very rich in butterfat, much richer it seems even than buffalo milk. The development of the butter and ghee industry of the area seems to me to require immediate action. A person with the Indian Dairy Diploma and therefore trained in the preparation of butter, ghee and cheese should be located for a few months at Senge Dzong or at Lubrang to teach the Monbas modern methods of making butter and ghee. Cheese making would require a bigger investment and may be postponed for the time being.

Agricultural Implements.

The Monbas use a plough which is altogether made of wood. Even the plough point is of wood This requires frequent renewal and is, therefore, detachable. It is wedged into the plough exactly after the manner of the blade of a carpenter's plane The only instrument needed for re-sharpening it or for replacing it is a *dao* which is carried by all Monba males, including small boys, on their waists. A steel point may be introduced to the area if steel can be dropped from aeroplanes with the aid of parachutes.

The Monba yoke is very long, about 12 feet or so in length. This allows a person to walk between the bullocks in order to control them while ploughing. If the bullocks are castrated and properly trained, it does not seem necessary that an extra person be utilized in this way for controlling them while ploughing. A shorter yoke (an Assam yoke for example) may be introduced to the area after trial.

The other minor agricultural implement I saw them use is a sort of a pick-axe, or a chisel attached to a handle in the form of an axe. This is used for breaking the clods left by the plough in covering the seeds sown. Sometimes a wooden mallet is also used in further breaking the clods. Both these operations which are now done mostly by females may be performed with the help of bullocks by "beaming," planking or "laddering."

Soil Erosion

Although the country is very mountainous, yet because of the low rainfall, the danger of erosion does not seem quite apparent. Terracing on steep slopes does not, therefore, appear to be economical, at least to the generation which does the terracing However, much of the rich surface soil in many parts of the area which *jhumming* has not touched or even in areas where *jhumming* had been practised for generations may be conserved by proper terracing. This, however, would have to be subsidized by Government, as otherwise the local people themselves may not do it as they do not see any immediate advantage in terracing.

Acknowledgment

I acknowledge with thanks the permission granted by J. P. Mills, Esq., C. I. E., I. C. S., Adviser to His Excellency the Governor of Assam, for the publication of this report.

WILT AND COLLAR ROT OF ORNAMENTAL CHRYSANTHEMUMS CAUSED BY SPECIES OF *FUSARIUM* AND BY *RHIZOCTONIA SOLANI* KUHN

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I. Introduction.

In September, 1941, wilted plants of chrysanthemum from the Mycological Section, Imperial Agricultural Research Institute, were examined to find out whether any causal organisms were responsible for the wilting of the hosts. The affected plants were carefully examined macroscopically as well as microscopically and it was found that there was a discoloration at the base of the stems rising to a distance of 1 to 2 inches from the collar. Sections from the diseased area showed the presence of a fungus mycelium with no sporulation. With a view to finding out the organism causing wilting and death of the host plants an experiment was carried out to see whether the fungi isolated were really responsible for the destruction of the host plants.

II. Historical Review.

Ikata (1928) reported that an undescribed species of *Fusarium* attacks the leaves and stems of the chrysanthemum in Japan causing wilting and death. White (1930) found *Fusarium culmorum* pathogenic to chrysanthemum and other hosts. White (1931) reported that *Fusarium* spp. caused stem rot and finally death of the host plants. Marchal (1932) found that *Fusarium dianthi* caused collar canker and wilting of chrysanthemum. Mme. Curzi (1933) reported that the species of *Fusarium* of the section Martiella caused wilting and death of the hosts. Servazzi (1939) described a wilt and decay of chrysanthemum caused by *Fusarium dianthi*. As yet wilting of chrysanthemum due to *Fusarium* spp. has not been reported from India.

III. Symptoms.

Roots of the affected plants were disintegrated, discoloured and brittle in nature. There were very few lateral roots. The stem was discoloured black with brownish streaks up to a height of 2 inches from the collar. The pith of the affected stems was partially rotten and broke easily. Leaves at first lose their turgidity, become yellowish after a time, turn brown, dry, and ultimately drop.

Once the leaves wither and dry up the plant gradually withers and dies. Younger plants are attacked more severely and the affected plants die before they can form buds and flowers. The fungus mycelium was found in the roots and to a height of 1·5 to 2 inches in the stem above the collar. Sections of the diseased material showed the presence of mycelium in the roots and the collar of the plants only.

IV. Isolation.

Wilted plants were carefully removed from the pots with the roots and the rootlets, the remaining soil round the roots was washed out with a fine jet of water so as to keep the roots and rootlets intact. The affected parts were cut into 1 cm. pieces which were surface sterilized in one per cent silver nitrate solution for two minutes and washed twice in sterilized four per cent sodium chloride solution to precipitate the silver chloride. The treated pieces were aseptically transferred to potato dextrose agar slants for growth and incubation. Seven isolations from each of the 14 wilted plants were made and a number of organisms were obtained as will be seen from table I.

TABLE I.

Number of organisms isolated from the different plants.

Plants	Organism	Number of isolations made
I and X ...	*Hormodendron* sp. ...	14
II and VII ...	*Fusarium* sp. ...	14
III	*Rhizoctonia solani* ...	7
IV, V and VI ...	*Fusarium* sp. ...	21
VIII and IX ...	*Fusarium* sp. ...	14
XI and XII ...	*Zythia bicolor* ...	14
XIII	*Helminthosporium* sp. ...	7
XIV	*Alternaria* sp. ...	7

V. Cultural Characteristics.

The fungi isolated were purified by means of single spore isolations (Ezekiel, 1930) and hyphal tip method (Brown, 1924) and grown on potato dextrose agar, prepared, as given by Riker and Riker (1936) to observe their cultural characteristics.

(*i*) Isolates from plants IX gave rise to a moderate growth of black surface mycelium. Mycelium was septate, sooty, collecting in knots. Sporulation took place in old cultures only.

(*ii*) Isolates from plants II and VII were species of *Fusarium* having abundant growth of cream coloured aerial mycelium; later on becoming pale ochraceous. Mostly hyperbolically curved macroconidia and light brown chlamydospores in chains were present. The stroma was leather brown in colour.

(*iii*) The isolate from plant III formed sparsely septate, thick light brown mycelium in culture, with many minute flat, irregular brown sclerotia distributed all over the agar surface. The hyphae branched at right angle after some distance from the point of origin and the mycelium collected together to form minute brown sclerotia after a time which were found fairly abundantly at the edge of the agar slants, and by the side of the glass tube.

(*iv*) Isolates from plants IV, V and VI were the same, being a species of *Fusarium*. Bluish green sporodochia were found irregularly and there was good growth of white aerial as well as surface mycelium. Macroconidia were found being thicker and shorter than those found in (*ii*). The chlamydospores were smaller, hyaline, intercalary or terminal.

(*v*) Isolates from plants VIII and IX were the same, a species of *Fusarium*. Both micro-and macro-conidia were found but the macroconidia were more strongly septate than before. No sporodochia were observed.

(*vi*) Isolates from plants XI and XII were the same being a species of *Sphaeropsidales*. Growth was scarce and white. Pycnidia were superficial cream or pale yellow of flesh coloured. Spores being elliptical one-celled and hyaline.

(*vii*) The isolate from plant XIII was a *Helminthosporium* sp. The conidiophores were rigid, septate and olive in colour. Conidia were small multiseptate and cylindrical.

(*viii*) The isolate from plant XIV was a fast growing species of *Alternaria*. Conidia were produced abundantly in chains, and both conidiophores and conidia were dark olive in colour.

VI. Pathogenicity.

To see whether the fungi isolated were parasitic to the host plants, soil inoculation with cultures of the different isolates was done and the young hosts were grown on the infected soil.

Method: The different isolates were grown on corn meal soil medium prepared as follows—

Ten per cent corn meal plus 90 per cent sieved soil and 30 c.c. of water for every 100 grms. of the mixture. 250 grms. of the medium was put in 500 c.c. "erlenmeyer" flasks and sterilized by autoclaving at 20 lbs. for two hours at a temperature of 120°C.

The inoculum was prepared by growing and incubating the various isolates on the corn meal soil medium for 15 to 20 days at 30°C (room temperature). After the period of incubation all the inoculum of each isolate was taken out separately and mixed well with four parts of garden soil (one part farmyard manure and three parts clay loam.) Approximately, 100 grams of the mixture was put round the root of each of the young plants, the mixture was lightly covered over with garden soil. The pots containing the infected plants were kept in the shade and watered till the plants had established themselves.

In each block there were three rows of eleven pots each, each pot containing one host grown in soil mixed with the inoculum of one particular isolate. There were 10 replicate each of one flower colour and one pot of the same colour as the control for one isolate. Fourteen isolates were replicated eleven times each for the three different flower colours giving a total of 462 eight inch pots containing the infected soil.

Observations on the inoculation experiment were taken 10 days after soil inoculation and continued for a period of four months. Soil inoculation was done from the 1st to 5th April, 1942, and the wilting of the plants was first noticed after a month. After the 28th of August, 1942, no more plants wilted and the number of plants affected by that time by the various organisms parasitic to the hosts are given in table II.

TABLE II

Results of the infection experiment

Culture of organisms	Number of plants infected	Isolations made	Percentage of infection	Organism isolated.
Hormodendron ..	2	4	nil	*Alternaria*
Fusarium sp. .	0	0	nil	nil
Rhizoctonia solani .	9	20	20	Original
Fusarium sp. ..	15	30	33	Original
Do.	10	20	27	Do.
Do	9	20	20	Original
Do.	10	20	16	Original
Do.	7	14	20	Original
Hormodendron .	1	2	nil	*Helminthosporium*
Zythia sp.	3	9	nil	*Alternaria*
Helminthosporium sp	0	0	nil	Nil
Alternaria sp. ..	1	2	nil	*Fusarium*

From the above table it is evident that the *Fusarium* sp. are chiefly responsible for the wilting and death of chrysanthemums, while *Rhizoctonia solani* is the other organism parasite to the host. Plants attacked by the latter organism exhibited similar symptoms to those attacked and killed by the *Fusarium* sp.

In the plants attacked by either of these organisms the vascular bundles of the host are attacked and clogged by the fungus mycelium thus stopping the flow of water and plant sap through the vessels causing the hosts to gradually wilt and ultimately die. In both instances of attack the collar and the roots are the most affected parts.

VII Morphology.

Cultures of *Fusarium* sp. were grown on two per cent potato dextrose agar and steamed rice respectively for 21 days at 20°C and 30°C to distinguish and separate them into the different species and sections. The different species were differentiated from one another by the colour, growth and the morphological characters. The various colours were identified from Ridgway (1912) and rice medium was prepared according to Wollenweber et al (1925). The Roman numerals with figures in brackets indicate the colour chart in Ridgway's colour standards, and colour nomenclature.

(*i*) The isolate from plants I and X was a species of *Hormodendron*. The colony on potato dextrose agar is black with a compact surface growth of moderate aerial mycelium. Hyphae are creeping and collect in clusters. Conidiophores are erect, septate and dark fuscous. Conidia are in chains, on the branches, globose to ovoid in shape and olivaceous to fuscous in colour.

(*ii*) The isolate from plants II and VII was identified as *Fusarium equiseti* (Cda.) Sacc. v. bullatum (Sherb.) Wr There was an abundant growth of aerial and surface mycelium, the colour in mass being whitish to pale ochraceous buff (XV-15′). Sporodochia and pionnotes are present. Microconidia and mostly macroconidia are found. Macroconidia are spindle to sickle shaped, not as curved as those in the typical representatives of the group. The basal cell is not always distinctly foot celled, the middle cells of the conidia are broader and slightly darker than the longer end cells: the apical cell is lengthened being whip shaped. Macroconidia are mostly 3 to 5 septate, the 3-septate conidia measure 33×3·75u usually 3·36×3·7-3. 8u, while the 5-septate conidia are 42×4·3u, the range being 31-47×4·1-4·9u. Chlamydospores are in chains usually intercalary and sometimes terminal; they are in clusters being globose to spherical one to two-celled the wall at first smooth later on becoming warty. The colour in mass being ochraceous buff (XV-15′) to buckthorn brown (XV-17′). The stroma as well as the substrata are leather coloured.

(*iii*) The organism isolated from the infected host III was *Rhizoctonia solani* cited by Rogers (1935) as *Botryobasidium solani* (Prill. and Del.) Donk. This colour of surface and serial mycelium is fawn, becoming darker with age. Hyphae branch freely, each branch bending towards its parent hyphae and running parallel to it The branches are constricted at the base and cut off from the parent hyphae by a septa which is 14 to 15u away from the point of origin. Minute dark brown solerotia are formed in clusters away from the centre, near the edge of the culture, and on the inside of the tube. Solerotia are irregular flat and crust like, composed of many short celled stout hyphae and irregular barrel shaped cells. The average width of the hyphae is 7·8u the range being 6·9 to 8·7u. Cells measure 60-130u×7·0-900u, and the solerotia 120-160u. No basidia or spores have been observed at any time during the experiment.

(*iv*) The isolate from plants IV, V and VI was *Fusarium solani* Mart.) App. et war. v. *minus* wr. The colony on potato dextrose agar is white, fluffy and abundant. Stroma is thin, pale pinkish buff (XXIX-17″. Greenish blue sporodochia are distributed irregularly. Microconidia are hyaline, oval to spindle shaped. Macroconidia are abundant, sausage shaped with blunt apex, not distinctly foot celled, hyaline 3 to 5 septate, the 3-septate measuring 30 × 4·5u, ranging being 25–33×4·1–5·3u, while 5-septate conidia measure 36×4·7u,

mostly 33—39×4·5—5·5u. Chlamydospores are rough, warty, hyaline mostly intercalary sometimes terminal. One-celled measuring 7·3u and two-celled measuring 12×7·3u, spherical in shape. Colour of the mycelium in the mass is pale vinaceous fawn XL—13′) to brownish white on rice medium.

(*v*) The isolate from plant VIII and IX was identified as a *Fusarium* sp. of the section Martiella. The colony on agar produced white moderate mycelium. Stroma is pinkish buff, and thin. Microconidia are oval to spindle shaped and macroconidia are abundant sausage shaped with blunt apex not distinctly foot-celled, hyaline but thicker than that in IV. Chlamydospores are rough, warty, hyaline, and mostly intercalary, spherical in shape.

(*vi*) The isolate from plants XI and XII was *Zythia licolor* (B. and Br.) Cooks and Mass. The colony was scarce, and white, small pycnidia are superficial to subsuperficial, flesh, cream or pale yellow in colour, spherical to sub-globose in shape, breaking easily, and have no mouth. Spores are elliptical minute, continuous and hyaline. Pycnidia measure 90—700u the average being 600u, Spores measure 3·0—3·4×1·7—2·2u the average being 3·2×1·9u.

(*vii*) The isolate from plant XIII was *Helminthosporium compactum* Karst. The colony in culture being olivaceous black (XLVI—21′). Mycelium is septate branched and sooty in colour.

Hyphae measure 70–120u×6–10u. Conidia ellipsoidal, 1-4 septate slightly sooty, measuring 12-24×6·0u.

(*viii*) The isolate from plant XIV was identified as *Alternaria viticola* P. Brun. Hyphal tufts are spread out and brownish conidia are slightly pediceliate, raised, yellowish brown in colour, in the beginning they are one-celled. Ultimately becoming 3—9 septate, the septa is constricted towards the end. Conidia measure 25—45×10—13.5u.

VIII Conclusions.

Of the eight different organisms isolated from the wilted plants only three proved to be pathogenic to the hosts, causing wilting and ultimate death as shown by the results of the infection experiment and re-isolation of these organisms from the affected host parts. Out of these three organisms *Fusarium solani* v. *minus* caused the most damage, the percentage of infection and loss being 27 per cent, while *Rhizoctonia solani* and *Fusarium* sp. of the section Martiella caused 20 and 18 per cent wilting and death of the host respectively.

The species of Fusarium parasitic to the chrysanthemum was similar to those recorded and described by Wollenber and Reinking (1935). While the Rhizoctonia re-isolated from the infected hosts is the same as described by Shaw (1912) as occuring on peanut, cotton, jute and cowpea. Butler (1918) records it on cowpea as *Hypochnus solani* and says that it is the sterile condition of a Basidiomycetous fungus allied to *Corticium* or *Hypochnus* and is found in association with the form having the perfect stage. Matz (1921) describes it as *Rhizoctonia solani*. Taslim (1928) reports a stem rot of berseem due to this fungus.

IX Summary

1. The wilting and stem rot of ornamental chrysanthemum was caused by three different organisms.

2. The causal organisms effecting the hosts are (*a*) *Fusarium solani* v. *minus*. (*b*) *Rhizoctonia solani Kuhn*, (*c*) *Fusarium* sp. of the section Martiella.

3. All the organisms caused a similar type of wilting of the hosts which were killed when young.

4. The causal organisms are high temperature fungi causing most damage during the rains.

5. The other five organisms isolated from the dead and wilted hosts were spro yphytes.

6. The plants with mauve coloured flowers were the most susceptible to the wilt, while the plants having yellow coloured flowers were most resistant to it.

7. Wilt and collar rot of chrysanthemum caused by *Fusarium* sp. or by *Rhizoctonia solani* has not been recorded in India so far. This therefore is a new record for India.

X Acknowledgment.

My grateful thanks are due to Dr. G. Watts Padwick, Ex-Imperial Mycologist, for suggesting the problem and for his kind interest and guidance in the work, and to Dr E. F. Vestal, Officiating Head of the Department of Agronomy, Agricultural Institute, Allahabad, for very kindly going through the manuscript, and his helpful criticism of the same.

References—

Butler, E. J. (1918). Fungi and diseases in plants. Thacker Spink and Co, Calcutta and Simla, pp. 264-265.

Curzi, Mme (1933). Il Depariments del Pireto nell isoladi cherso. Boll R. staz. pet. veg. N. S. 13, 537-553. Seen in R.A.M. p. 306, 1934.

Ezekiel, W. N. (1930). Modified procedure with Keitts single spore method. Phytopath 20, 583-586.

Ikata, S. (1928). Fungus diseases of the Insect powder plants. Ann. Phytopath. Soc. Japan 2, 149-158. Seen in R.A.M. p. 174, 1929.

Matz, J. M. (1921). Rhizoctonias of Porto Rico. Jour. Dept. Agric Porto Rico, 5 No. 1.

Marchal, E. (1932). Observations et recherches effectuees a' la station de Phytopathologie de I Etat pendent l' anne. Seen in R.A.M, p. 676, 1931.

Rogers, D. P. (1935), Notes on lower Basidiomycetes, Univ. Iowa Stud. Nat. Hist. 17, 17-19.

Riker, A. J. and R. S. Riker (1936). Introduction to research on plant diseases. Printed in U. S. A.

Ridgway, R. (1912). Colour standards and colour nomenclature. Washington D. C.

Saccardo, P. A. (1886-1931). Sylloge Fungorum 4—25. Patavii.

Servazz, O. (1939). Appuntidi fitopatologi. (Phytopath. Notes). Boll. Lab. sper. R. oss. Fitopati Torino, 16, 119-32. Seen in R.A.M. 1939.

Shaw, F. J. F. (1921). Morphology and Parasitism of Rhizoctonia. Mem. Dept Agric. India, 4, No. 6.

Taslim, M. (1928). Stem rot of berseem caused by R. solani Kuhn. Agri. Res. Inst. Bull. 180.

White, H. L. (1930). Wilt disease of carnation spp. Seen in R.A.M. p. 37, 1930.

White, P. (1931). Diseases of chrysanthemum. N. J. Agri. Expet. Sta. Circ. No. 233.

Wollenweber, H.W. et al (1925). Fundamentals for taxonomic studies of Fusarium. Jour. Agri. Res 30, 833-843.

Wollenweber, H.W. and O. A. Reinking (1935). Die Fusarien. Verlagsbuchhandlung Paul Parey, Berlin.

BLOOD MEAL*

By

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Men, poultry and swine are omnivorous animals. Many of India's millions habitually have a diet approaching the vegetarian, but even the most orthodox Hindu admits the necessity of milk or milk products in the diet if one is to maintain his health and strength through an otherwise vegetarian diet.

Animal products in diets.

The main necessity for animal products in this diet is the need for supplying essential amino-acids which are not found in the plant proteins. The cow, horse, goat, sheep, rabbit and elephant require animal protein in their extreme youth only. After a few months they are weaned from their mother's milk and from that time onwards subsist on a completely vegetarian diet. Some animal husbandmen in India try to raise their poultry and swine on a diet that does not provide sufficient animal products If a few hens are kept and are allowed free range they can usually find enough worms and insects to balance their diet ; if, on the other hand, large numbers of fowls are kept in confinement, adequate provision must be made for a supplementary protein concentrate of animal origin. Many substances have been used successfully and poultry-keepers throughout the world recognize the value of milk products, fish meal, meat meal, tankage and blood meal in the diet of fowls. In India many householders buy offal from the butcher and after cooking it chop it up and feed it to their poultry. The main drawbacks in the use of this product are that it is often difficult to secure sufficient of the material, that it is sometimes difficult also to get the material in a fresh state, that considerable effort is necessary to prepare it for the fowls, and that the material is of poor keeping quality. One reason why so little animal protein is used in the diet of men and omnivorous animals in India is because this is usually the most expensive item of the diet. Another drawback is that these animal products are the most difficult of all foods to keep fresh and palatable.

Here at the Agricultural Institute we formerly used skimmed milk, whey, butter-milk and offal for our poultry. Upon starting our piggery and enlarging our poultry enterprise, we were soon faced with a shortage of animal products for feeding, therefore, we explored the possibilities of other sources. The most promising source seemed to be blood meal. This product has had very limited use for the purpose for which we required it, but has been used primarily as a fertilizer, especially for sugarcane and similar crops needing the addition of considerable nitrogen to the soil for maintaining soil fertility. The blood meal as available in Indian markets is entirely unsuitable for feeding purposes, because it is usually prepared near the city boneyard and is, undoubtedly, adulterated with earth containing bacteria, many of which would be pathogenic for livestock. Since much of this commercial blood meal has remained moist for a long time and has undergone putrefaction, it is less palatable and of a lower nutritional value than it would be if it had been dried thoroughly while fresh. It was soon evident to us that in order to assure ourselves of a satisfactory product we must prepare it ourselves.

Method of preparation.

After some experimentation we developed a simple, effective method of preparation. All the equipment needed can be secured or prepared easily in the bazaar of an average Indian city. We use a large iron kettle (*karahi*) over an open

* Reproduced from the *Indian Farming, Vol. VII, No. 5, May,* 1946.

fire for heating the blood. A press similar to that used for making cider expresses the extra moisture from the cooked blood. This press can be made from the nut and screw as commonly employed in commercial *sanai* machines. The only other items of equipment required are containers for the blood and a flat, dry, sunny surface. We bring the blood from the slaughter-house in a bull-drawn night-soil cart and the prepared product is dried on a cement roof.

In many of the slaughter-houses in Indian cities the blood is completely wasted, in others it is collected and prepared for fertilizer. We contract for all the fresh blood daily for a period of ten months of the year. Our men fill the cart with the fresh clotted blood accumulating in the gutter as the animals are being slaughtered. Upon their return to our farm they heat to boiling about three gallons of water in the iron kettle and pour in ten gallons of the blood. It takes about a half-an-hour of heating with continuous stirring with a spade to cook the blood completely, the stirring is very necessary to prevent scorching and resultant lowered palatability. As soon as the blood becomes firm and similar in consistency and appearance to chunks of cooked liver it is removed to the press. Several pounds of water are squeezed out of it and thrown into the irrigation ditch. The resulting cake of blood is kept in covered tins overnight. (Animals are slaughtered late in the evenings, so that it is impossible to have the product ready for drying until late at night.) The longer the moist cakes stand the greater is the loss of protein. One can smell ammonia as it evaporates from the decomposing mass. Maggots also develop within a few hours. Thus it is essential that the cake be broken up into small particles and spread as thinly as possible over a hard surface exposed to the strong rays of the sun immediately. During the days when the sun's heat is intense the blood becomes dry and hard within one day. At other times two or three days of drying may be necessary; in this case it is a good practice to remove the blood in the late afternoon to prevent its becoming moist from dew. When the blood is completely dry it becomes black and brittle, in many ways resembling charcoal. It can then be broken up on a *sil* or crushed under a heavy iron or stone hammer. We prefer to grind our meal in a hammer mill. During moist weather, especially, a strong odour as of burnt feathers comes from the hammer mill; but if the product has been properly prepared it is quite odourless. The black blood meal will keep for months in a dry place; if it is allowed to become wet, maggots develop in it and the protein begins to disintegrate and give off ammonia.

The British Method

During the present war the British have used a good deal of blood in feeding their poultry and it has been recommended in Britain that blood be cooked in a bag within a container of boiling water, this cooked blood is then fed moist to their poultry. We prefer to use our blood as meals in a dry state. This meal is mixed with grain and grain products to form a poultry mash or for feed for other livestock. The resulting feed may be moistened or fed dry; but in no case may more be moistened than will be consumed within a few minutes, since it deteriorates rapidly when moist. We moisten it only when we have whey or buttermilk to be fed to the poultry.

Suggestion for feeding.

Blood meal contains the greatest amount of protein of any feed stuff. The figure usually given is approximately 82 per cent protein. Analysis of some of our meal shows approximately 90 per cent protein Meat scrap contains about 55 per cent protein and few of the oil cakes contain more than 35 or 40 per cent protein. Thus it is evident that blood meal is a very concentrated feed. The following (Table I) is a suggestion for feeding poultry when blood meal is to be the only source of animal protein in the diet.

TABLE I.

Suggestion for feeding poultry when blood meal is the only source of animal protein

Mash feed.		*Scratch feed.*	
Maize (ground)	30 lb.	Whole barley	30 lb.
Wheat bran	20 ,,	*Jowar*	26 ,,
Ground barley	10 ,,	Whole wheat	26 ,,
Linseed oil cake	6 ,,		
Blood meal	12 ,,	Total	82 lb.
Mineral mixture	4 ,,		
Total	82 lb.		

These two feeds can be mixed together in equal quantities and fed in a trough or the mash may be fed in a hopper and the scratch feed scattered in litter or on clean ground. We prefer to feed both mixed together in a special trough. We find that this mixture maintains the growth and development of our poultry and keeps up the egg yield. For temporarily increasing the protein content of the feed we mix less of the scratch mixture with the mash mixture, this is done in the case of young chicks. The mash mixture contains 23·5 per cent protein and a mixture of the two feeds in equal amounts contains 17·7 per cent protein.

Very little scientific information is available on the value of blood meal as feed and it is a popular belief among feeders in America that it is of fairly low biological value as compared with the other sources of animal protein. Tests, however, have shown that the digestibility of blood is very high and there is little evidence to support this prejudice. We feel that if the blood which is now wasted throughout India could be made into blood meal of a quality suitable for feeding livestock, India's wealth would be increased and millions of her protein-starved animals could be more adequately fed.

THE RELIABILITY OF RANIKHET VACCINE**

It is often asked—what proof is there, outside the laboratory, that the Ranikhet-disease vaccine evolved at Mukteswar is effective? The following note contains an answer.

Heavy mortality was experienced in one pen on the Military Poultry Farm adjacent to the Imperial Veterinary Research Institute Poultry Farm on 2nd January, 1946, but, owing to deaths from other causes including fowl cholera, the presence of Ranikhet disease was not recognized until 8th January, 1946. Necessary instructions regarding isolation of the affected pen were issued as soon as the losses occurred, but, eventually, the disease spread to the greater part of the farm and over 3,000 birds were lost during the month of January. None of the birds had been previously inoculated against Ranikhet disease with chick embryo vaccine. Vaccination on the military farm was begun on 24th January, 1946, and completed on 26th January, 1946. Losses from Ranikhet disease were last recorded five days after the completion of vaccination.

Cases of Ranikhet disease were diagnosed in one pen on the Imperial Veterinary Research Institute Poultry Farm on 3rd January, 1946, and eventually, three pens containing a total of 48 birds were involved. In these pens 22 birds had previously been inoculated against Ranikhet disease, some in 1944 and the others in 1945. Seventeen birds out of the 26 non-vaccinated ones died from Ranikhet disease, while no deaths occurred amongst the vaccinated ones. All the birds in the three affected pens were quarantined in their houses as soon as disease was suspected, and the non-vaccinated birds in these as well as in the adjacent pens were vaccinated against Ranikhet disease within 48 hours. A fresh outbreak of the disease was diagnosed on the 5th February, 1946, in one pen of non-vaccinated chickens in a brooder house; vaccination of these birds had not been done as they were considered to be too young for routine vaccination. All the birds in the affected pen were destroyed to prevent any possible spread of the disease to the other pens and the rest of the birds were vaccinated without delay. No losses from the disease were experienced in any of the other pens.

The high losses experienced on the Military Poultry Farm can be attributed to failure to carry out routine vaccinations with the vaccine which has been recently evolved at the Institute, delay in carrying out vaccination once the disease was diagnosed, and breakdown in quarantining the affected pens from the healthy ones. The comparative low losses in the pens on the institute's farm can be attributed to previous vaccinations against Ranikhet disease, over 90 per cent of the total stock in the runs had previously been vaccinated, prompt quarantining of affected pens and vaccination of the non-vaccinated birds in the affected and adjoining pens. In fact, a striking feature of the outbreak was the absence of Ranikhet disease among birds which had been vaccinated in 1944 or 1945.—*Imperial Council of Agricultural Research.*

** Reproduced from the *Indian Farming, Vol. VII, No. 5, May,* 1946.

New Books and Reviews*

THE FIELD PUBLICITY ORGANIZATION

(Issued by the Central Office of the Field Publicity Organization, Department of Information and Broadcasting, Government of India.)

With the cessation of hostilities, the different post-war plans for the improvement of rural India are awaiting execution. For working out these plans in an efficient manner, the people for whom these welfare measures are meant, should be told about these. For it is on the understanding and co-operation of the villagers themselves that persons charged with the welfare work must, to a great extent, depend. Publicity should, therefore, form an integral part of these post-war developmental schemes. The brochure under review provides an excellent guide which will go a long way to make publicity work in villages easy, effective and systematic. The aim should be to develop in the villagers a desire to work of their own accord for better villages. This can be achieved by educative publicity, by stimulating and canalizing the energy, interest and enthusiasm of the people for better living.

The problem is the medium through which such educative programmes can be brought to the notice of those for whom they are meant. Obviously, film publicity, 'the best form of audio-visual publicity' is the most helpful means of providing authentic information. Since the supply of information films must necessarily be limited these can be supplemented by lectures, illustrated by lantern slides or pictures. Exhibitions and demonstrations are important in visual publicity and competitions and shows are 'the strongest stimulant and spur to development effect.' A consideration of various other means of propaganda has also been included. A comparative estimate of different methods of propaganda has been given and the suitability of particular types for particular occasions or for particular purposes emphasized. Entertainment may be profitably combined with propaganda through dramas, songs, and broadcasting of rural programmes.

A scheme of Field Publicity Organization, the 'F. P. O.', has been given and the functions of each office defined. "The 'F. P. O.' consists of a Central organization with the Government of India which acts as an initiating, guiding and co-ordinating agency and, in the provinces, Provincial Organizations which form a branch of the Provincial Publicity under the Provincial Government, ...the basis of the Provincial Organization is a fleet of Mobile Publicity Units of which, as the first stage, one unit is based in each Civil District." The District Unit, happens to be the foundation of the 'F. P. O.', 'The Unit comes under the general administrative control of the District Officer.'

Plans for conducting well-conceived and carefully organized publicity campaigns have been set out in great detail. Each campaign must have a definite object and a clear-cut plan of action, all the possible means of propaganda ought to be utilized to gain the objective.

There is a valuable appendix to the booklet giving instruction regarding the management, administration and control of the 'F. P. O'. The duties of the staff have been detailed therein and the proper maintenance of all equipment has been stressed.

The brochur is well-written and neatly printed with an attractive get-up. It is a useful publication and may very well serve as a veritable text and reference book to all persons interested in publicity work.....U. N. C.

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* These reviews have been reproduced from the *Indian Farming, Vol. VII, No. 5, May* 1946.

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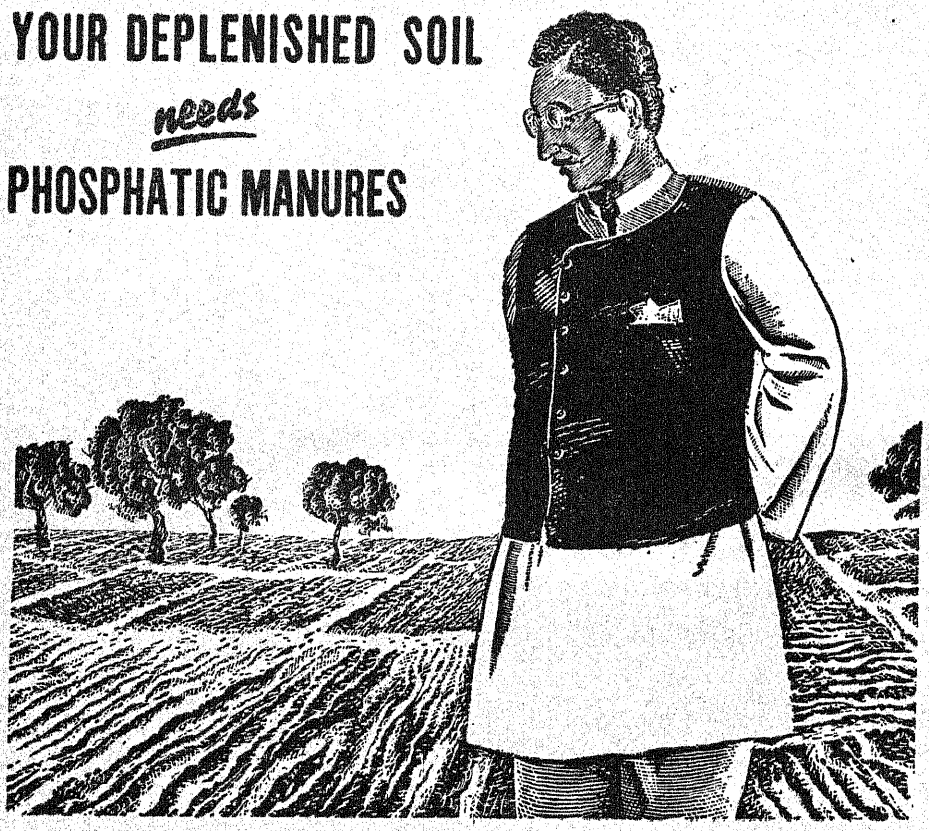

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